FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management, Bureau of Watershed Management

SOUTHWEST DISTRICT • TAMPA BAY TRIBUTARIES

TMDL Report

Fecal Coliform and Total Coliform TMDL for Williams Creek,

WBID 1901

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Acknowledgments

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TMDL Program

http://www.dep.state.fl.us/water/tmdl/index.htm

Identification of Impaired Surface Waters Rule

http://www.dep.state.fl.us/water/tmdl/docs/AmendedIWR.pdf

STORET Program

http://www.dep.state.fl.us/water/storet/index.htm

2002 305(b) Report

http://www.dep.state.fl.us/water/docs/2002_305b.pdf

Criteria for Surface Water Quality Classifications

http://www.dep.state.fl.us/legal/rules/shared/62-302t.pdf

Basin Status Report for the Tampa Bay Tributaries Basin

http://www.dep.state.fl.us/water/tmdl/stat_rep.htm

Water Quality Assessment Report for the Tampa Bay Tributaries Basin

http://www.dep.state.fl.us/water/tmdl/stat_rep.htm

Allocation Technical Advisory Committee (ATAC) Report

http://www.dep.state.fl.us/water/tmdl/docs/Allocation.pdf

U.S. Environmental Protection Agency

Region 4: Total Maximum Daily Loads in Florida

http://www.epa.gov/region4/water/tmdl/florida/

National STORET Program

http://www.epa.gov/storet/

Chapter 1: INTRODUCTION

1.1 Purpose of Report

This report presents the Total Maximum Daily Load (TMDL) for fecal and total coliform for Williams Creek in the Manatee River Basin. The creek was verified as impaired for fecal and total coliform, and was included on the Verified List of impaired waters for the Manatee River Basin that was adopted by Secretarial Order on May 27, 2004. The TMDL establishes the allowable loadings to the Williams Creek that would restore the waterbody so that it meets its applicable water quality criterion for fecal and total coliform.

1.2 Identification of Waterbody

Williams Creek, located in Manatee County, is a small tributary to the Braden River, which is a tributary to the Manatee River and the lower portion of Tampa Bay, near the city of Bradenton **(Figure 1.1).** The creek is a meandering stream that is about 3.91 miles long, extending from the 40 foot elevation contour to the Braden River, has a water surface area of 0.037 square miles, and has a total drainage area at its junction with the Braden River of 3.56 square miles. The major center of population in the basin is Bradenton, a city of about 50,000 at the southwest end of the Manatee River Basin. Williams Creek is a second-order, stream, and, along its length, it exhibits characteristics associated with riverine aquatic environments. Additional information about the river's hydrology and geology are available in the Basin Status Report for the Tampa Bay Tributaries Basin (Florida Department of Environmental Protection, 2002).

For assessment purposes, the Florida Department of Environmental Protection (the Department) has divided the Manatee River Basin into water assessment polygons with a unique **w**ater**b**ody **id**entification (WBID) number for each watershed or stream reach. Williams Creek has been assigned WBID 1901, as shown in **Figure 1.2**

1.3 Background

This report was developed as part of the Department's watershed management approach for restoring and protecting state waters and addressing TMDL Program requirements. The watershed approach, which is implemented using a cyclical management process that rotates through the state's 52 river basins over a 5-year cycle, provides a framework for implementing the TMDL Program-related requirements of the 1972 federal Clean Water Act and the 1999 Florida Watershed Restoration Act (FWRA, Chapter 99-223, Laws of Florida).

A TMDL represents the maximum amount of a given pollutant that a waterbody can assimilate and still meet water quality standards, including its applicable water quality criteria and its designated uses. TMDLs are developed for waterbodies that are verified as not meeting their water quality standards. TMDLs provide important water quality restoration goals that will guide restoration activities.

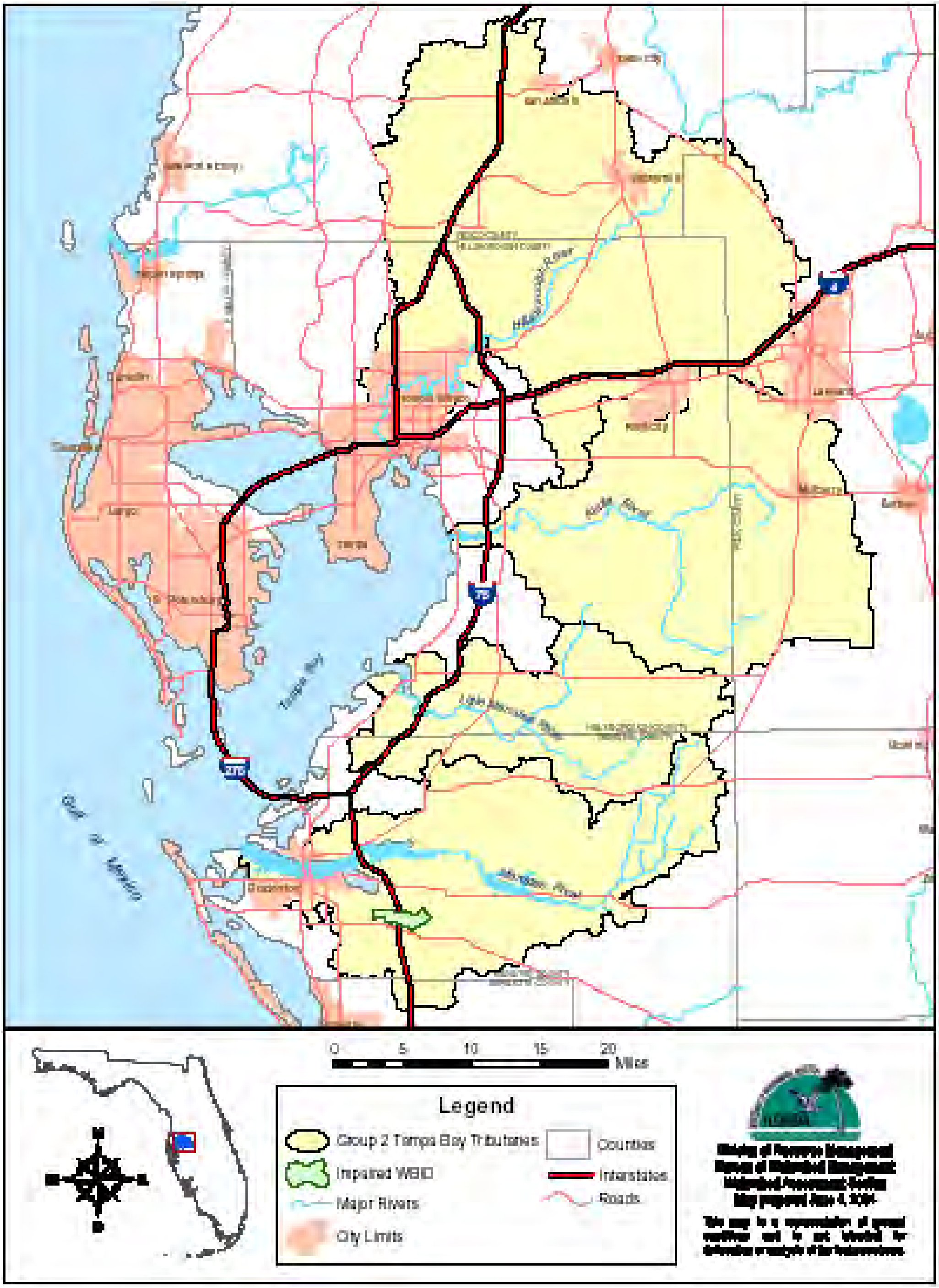
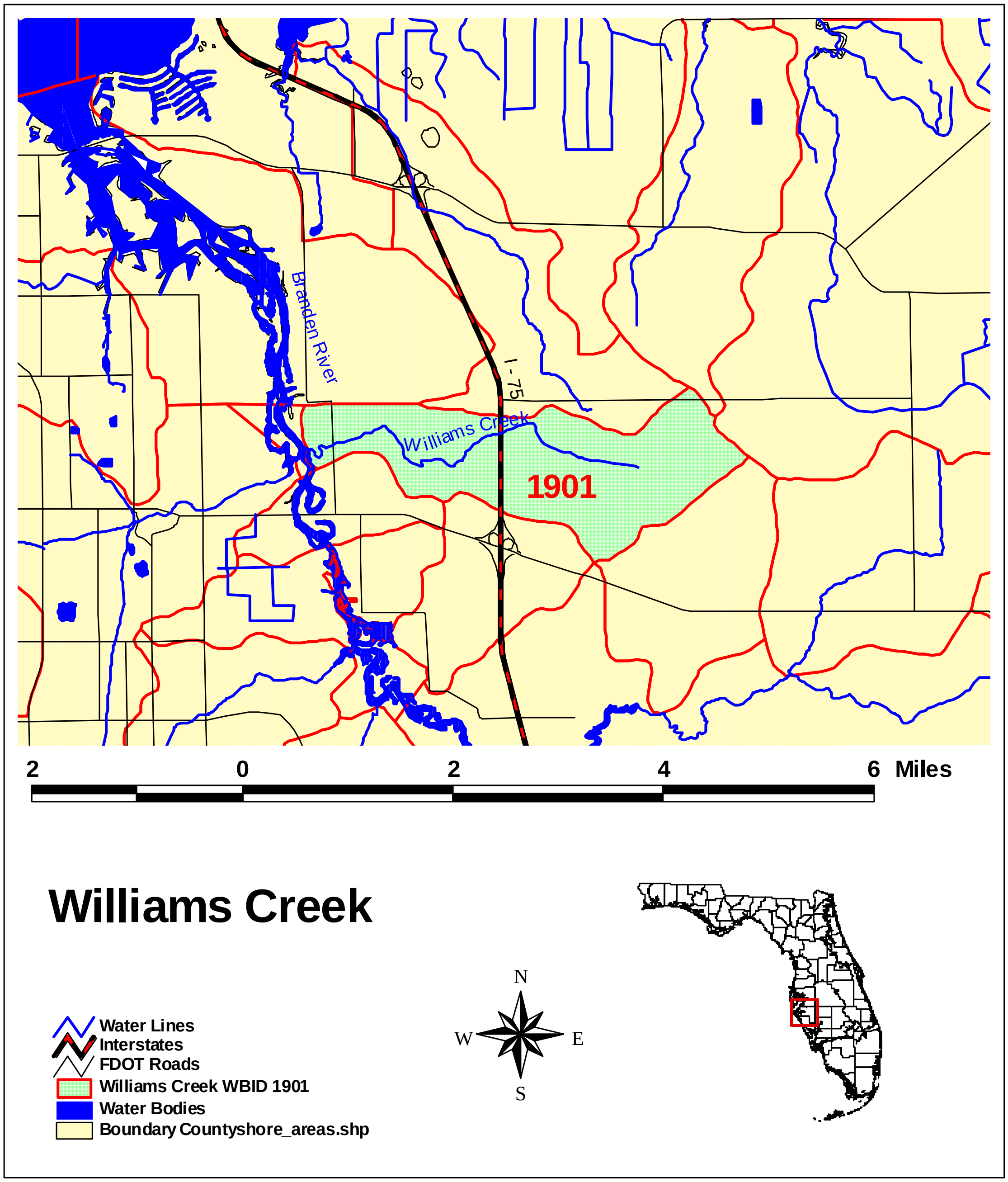


Figure 1.1. Location of Williams Creek and Major Geopolitical Features in the Manatee River Basin

Figure 1.2. WBIDs in the Williams Creek Basin



This TMDL Report will be followed by the development and implementation of a Basin Management Action Plan, or BMAP, to reduce the amount of fecal and total coliform that caused the verified impairment of Williams Creek. These activities will depend heavily on the active participation of the Southwest Florida Water Management District, local governments, businesses, and other stakeholders. The Department will work with these organizations and individuals to undertake or continue reductions in the discharge of pollutants and achieve the established TMDLs for impaired waterbodies.

Chapter 2: DESCRIPTION OF WATER QUALITY PROBLEM

2.1 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act requires states to submit to the EPA a list of surface waters that do not meet applicable water quality standards (impaired waters) and establish a TMDL for each pollutant causing the impairment in each of these waters on a schedule. The Department has developed such lists, commonly referred to as 303(d) lists, since 1992. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (Subsection 403.067[4)] Florida Statutes [F.S.]), and the state's 303(d) list is amended annually to include basin updates.

Florida's 1998 303(d) list included 10 waterbodies in the Manatee River Basin; however, the FWRA (Section 403.067, F.S.) stated that all previous Florida 303(d) lists were for planning purposes only and directed the Department to develop, and adopt by rule, a new science-based methodology to identify impaired waters. After a long rule-making process, the Environmental Regulation Commission adopted the new methodology as Chapter 62-303, Florida Administrative Code (F.A.C.) (Identification of Impaired Surface Waters Rule, or IWR), in April 2001.

2.2 Information on Verified Impairment

The Department used the IWR to assess water quality impairments in Williams Creek and verified the impairments for fecal and total coliform (**Table 2.1)**. The fecal and total coliform impairment was verified with recently obtained data. Some of these data are included in **Appendix G. Table 2.2** provides assessment results for fecal and total coliform for each waterbody segment during the verification period.

Table 2.1. Verified Impaired Segments in the Williams Creek Basin

WBID	Parameters of Concern	Priority for TMDL Development	Projected Year for TMDL Development
1901	FECAL COLIFORM	HIGH	2003
1901	TOTAL COLIFORM	HIGH	2003

Note: The parameters listed in **Table 2.1** provide a complete picture of the known impairments in the river.

Table 2.2. Fecal Coliform and Total Coliform Data

Station Number	Data Provider	Date	Fecal Coliform (N/100mL)	Total Coliform (N/100mL)
21FLTPA 24010071	FDEP	9/29/98	**1010**	1600
21FLTPA 24010071	FDEP	03/27/02	**2000**	**3200**
21FLTPA 24010071	FDEP	04/10/02	**480**	2100
21FLTPA 24010071	FDEP	05/22/02	**990**	1200
21FLTPA 24010071	FDEP	05/29/02	**550**	1040
21FLTPA 24010071	FDEP	07/16/02	**660**	1460
21FLTPA 24010071	FDEP	08/12/02	**2100**	**3400**
21FLTPA 24010071	FDEP	09/11/02	**3500**	**4200**
21FLTPA 24010071	FDEP	10/22/02	**1280**	2150
21FLTPA 24010071	FDEP	11/04/02	110	1400
21FLTPA 24010071	FDEP	6/26/03	140	**3000**
21FLTPA 272711288228054	FDEP	03/27/02	400	610
21FLTPA 272711288228054	FDEP	04/10/02	60	410
21FLTPA 272711288228054	FDEP	05/22/02	110	1100
21FLTPA 272711288228054	FDEP	05/29/02	**450**	900
21FLTPA 272711288228054	FDEP	07/16/02	400	1900
21FLTPA 272711288228054	FDEP	08/12/02	280	540
21FLTPA 272711288228054	FDEP	09/11/02	**570**	**2700**
21FLTPA 272711288228054	FDEP	10/22/02	140	1120
21FLTPA 272711288228054	FDEP	11/04/02	30	1750
21FLTPA 272711288228054	FDEP	6/26/03	100	**2500**

Note: Numbers in **bold** exceed the criteria (400 N/100mL for Fecal Coliform, 2400 N/100mL for Total Coliform).

Chapter 3. DESCRIPTION OF APPLICABLE WATER QUALITY STANDARDS AND TARGETS

3.1 Classification of the Waterbody and Criteria Applicable to the TMDL

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	**Potable water supplies**
Class II	**Shellfish propagation or harvesting**
Class III	**Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife**
Class IV	**Agricultural water supplies**
Class V	**Navigation, utility, and industrial use (there are no state waters currently in this class)**

Williams Creek is a Class III waterbody, with a designated use of recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife. The Class III water quality criterion applicable to the impairment addressed by this TMDL is fecal coliform and total coliform.

3.2 Applicable Water Quality Standards and Numeric Water Quality Target

Numeric criteria for bacterial quality are expressed in terms of fecal coliform bacteria and total coliform bacteria concentrations. The water quality criteriafor the protection of Class III waters, as established by Chapter 62-302, F.A.C., states the following:

> ***Fecal Coliform Bacteria:***
> *The most probable number (MPN) or membrane filter (MF) counts per 100 ml of fecal coliform bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 percent of the samples, nor exceed 800 on any one day.*
>
> ***Total Coliform Bacteria:***
> *The MPN per 100 ml shall be less than or equal to 1,000 as a monthly average nor exceed 1,000 in more than 20 percent of the samples examined during any month; and less than or equal to 2,400 at any time.*

For both parameters, the criteria state that monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30-day period. During the development of load curves for the impaired streams (as described in subsequent chapters), there were insufficient data (fewer than 10 samples in a given month) available to evaluate the geometric mean criterion for either fecal coliform or total coliform bacteria. Therefore, the criterion selected for the fecal coliform TMDL was not to exceed 400 counts/100 ml in 10 percent of the samples and the total coliform TMDL was not to exceed 2400 counts/100 ml at any time.

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Chapter 4: ASSESSMENT OF SOURCES

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of the pollutant of concern in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term point sources has meant discharges to surface waters that typically have a continuous flow via a discernable, confined, and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) are examples of traditional point sources. In contrast, the term "nonpoint sources" was used to describe intermittent, rainfall driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses, agriculture, silviculture, and mining; discharges from failing septic systems; and atmospheric deposition.

However, the 1987 amendments to the Clean Water Act redefined certain nonpoint sources of pollution as point sources subject to regulation under the EPA's National Pollutant Discharge Elimination (NPDES) Program. These nonpoint sources included certain urban stormwater discharges, including those from local government master drainage systems, construction sites over five acres, and a wide variety of industries (see **Appendix A** for background information on the federal and state stormwater programs).

To be consistent with Clean Water Act definitions, the term "point source" will be used to describe traditional point sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring an NPDES stormwater permit when allocating pollutant load reductions required by a TMDL (see **Section 6.1**). However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater.

4.2 Potential Sources of Fecal Coliform in the Williams Creek Watershed

4.2.1 Point Sources

There are only two wastewater treatment facilities that are permitted to discharge to surface waters (DEP, 1979; Palmer, 1980; Degrove, 1984; Degrove, 1986) near Williams Creek **(Appendix C).** These include the City of Bradenton domestic WWTF and Tropicana Products, Inc., a citrus processing plant. Effluent from both facilities is discharged into the Manatee River, east of US 41 and downstream of the Braden River.

The Bradenton WWTF has a design capacity of 9.0 million gallons per day (MGD) (FDEP, 2002). According to the Department's monitoring records, the average monthly flow for 2003 was 5.683 MGD. The Tropicana facility has a design flow of 0.6 MGD.

A list of all major dischargers in the Manatee River Basin, including facilities that do not discharge to surface waters, is provided in **Appendix C**.

Municipal Separate Storm Sewer System Permittees

There is a Phase II Municipal Separate Storm Sewer Systems (MS4s) Permit (FLS000037) in the Manatee River Basin. The stormwater collection systems owned and operated by the City of Bradenton are currently covered by an MS4 permit (COB, 2000)

4.2.2 Land Uses and Nonpoint Sources

Additional fecal and total coliform loadings to Williams Creek are generated from nonpoint sources in the watershed. Potential nonpoint sources of coliforms include loadings from surface runoff, wildlife, livestock, pets, leaking septic tanks and sewer lines, marinas, houseboats and other watercraft. Ground water data (Appendix F) for the Manatee River Basin do not show any exceedances for fecal coliform (400/100 ml) in the aquifers.

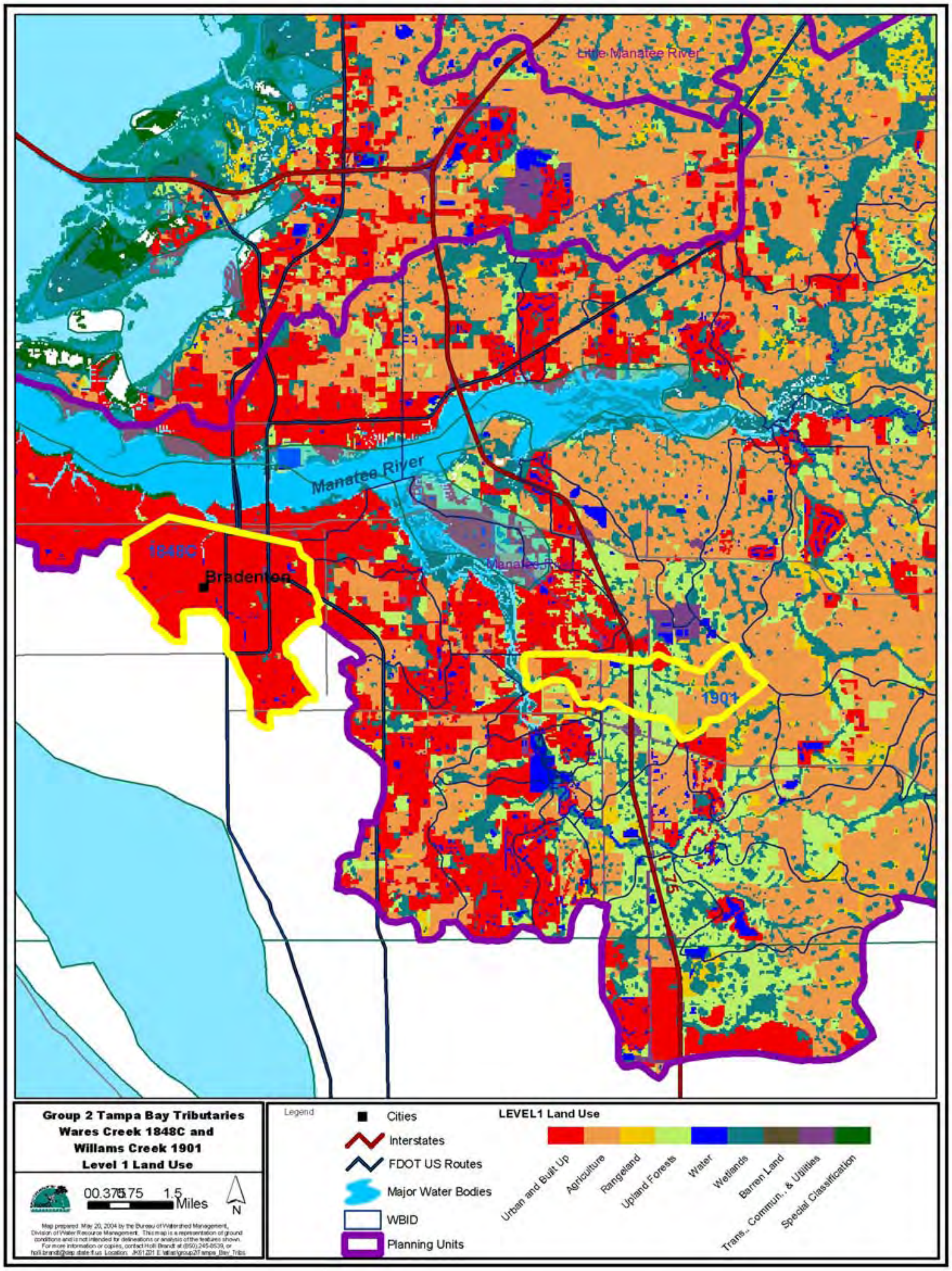
Land Uses

The spatial distribution and acreage of different land use categories were identified using the 1999 land use coverage (scale 1:40,000) contained in the Department's geographic information system (GIS) library. Land use categories in the watershed were aggregated using the simplified Level 1 codes tabulated in **Table 4.2.** **Figure 4.2** shows the acreage of the principal land uses in the watershed. Most of the land is Agriculture (46.6%), Upland Forest (20.1%), and Wetlands (14.7%), with Urban and Built Up (9.7%) being a very small amount compared to the other Level 1 categories. A detailed summary of various land use loads by category is included in **Appendix B**.

Table 4.2. Classification of Land Use Categories in the Williams Creek Watershed, WBID 1901at Mouth

Code	Land Use	Acreage	Square Miles
1000	Urban and Built-Up	221.3	0.35
2000	Agriculture	1063.4	1.66
3000	Rangeland	99.0	0.15
4000	Upland Forests	458.1	0.72
5000	Water	34.5	0.05
6000	Wetlands	336.1	0.52
7000	Barren Land	4.5	0.01
8000	Transportation, Communications	63.0	0.10
Total		2279.9	3.56

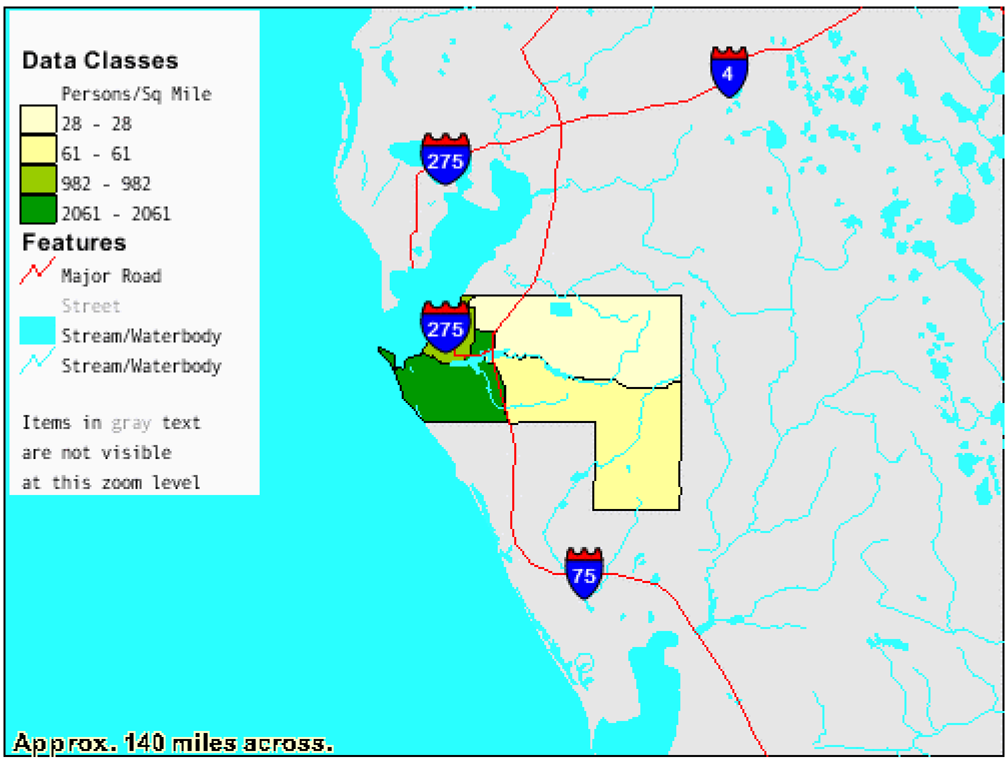
Figure 4.2. Principal Land Uses in the Williams Creek Watershed



Population

According to the U.S Census Bureau (2004), the total population in Manatee County, which includes WBID 1901, was 264,002 with 138,128 housing units. For all of Manatee County, the Bureau reported a housing density of 356.3 houses per square mile **(Figure 4.3)**. This places Manatee County among the highest in housing densities in Florida (U.S. Census Bureau Web site, 2004).

Figure 4.3. Population Density in Manatee County, Florida



See if you can fix this to show ranges of values for the number of people per square mile.

Septic Tanks

Approximately 89.2 percent of the residences in the county are connected to the wastewater treatment plant, with the rest utilizing septic tanks (U.S. Census 1990). As of 2001, the Florida Department of Health (FDOH) reported that there were 38,482 permitted septic tanks in Manatee County (Florida Department of Health Web site, 2004). From fiscal years 1991 – 2002, 784 permits for repairs were issued, with no permits recorded as issued for repair in fiscal year 1993 (Florida Department of Health Web site, 2004).

WBID 1901 comprises 3.56 square miles, or approximately 0.48 percent of the land area of Manatee County (741.43 square miles). The ratio of square miles of Level 1 land use category "Urban and Built Up" in the WBID to the square miles of Level 1 "Urban Built Up" for Manatee County was used to estimate the number of septic tanks in WBID 1901, as shown in **Appendix B**. This translates to about 126.5 septic tanks for the entire WBID 1901.

Between 1991 and 2002, an average of 78.4 permits per year was issued in the county for septic tank repairs. This number is about 0.204 percent of the total at any time. Previous studies (CDM, 1998) have shown that failed septic tanks are not discovered for about 5 years. This means that the true failure rate at any time is approximately five times the repair rate of 0.204 percent, or 1.02 percent. As a margin of safety (MOS), the Department assumed the failure rate was twice that, or 2.0 percent of the total septic tanks within each WBID. Using these numbers (Florida Department of Health Web site, 2004) and 70 gallons/day/person (U.S. Environmental Protection Agency, 2001), a loading of 1.743E10 colonies/day was computed for the 2.53 estimated failed septic tanks in the entire WBID 1901 watershed (Table 4.3).

The potential loading from sewer line leaks was estimated assuming 5% of design flow (within each WBID) is leached from the system (EPA, 2003) at a concentration of 1.0E6 cfu/100 ml (EPA, 2001).

Table 4.3. Estimation of Coliform Loading from Failed Septic Tanks in the Williams Creek Watershed

Estimated Population Density and Area	Estimated Number of Septic Tanks in Area	Estimated Number of Tank Failures	Estimated Concentration From Failed Tank (cfu/100mL)	Gallons/ Person/ Day	Estimated Number of People Per Household	Estimated Load From Failing Tanks (cfu/day)
Based on estimate of people in the 3.56square-mile area of urban/built-up land in Williams Creek, WBID 1901	126.5	2.53	1.0E6	70	2.6	1.743E10

Livestock and Wildlife

Animal fecal matter, whether from livestock or wildlife, can be a significant source of coliform loadings to streams, depending on the number of animals, their location relative to the stream, and the best management practices (BMPs) used at individual agricultural operations. **Table 4.4** summarizes the estimated average daily fecal coliform loadings from 1990 through 2002, based on the numbers of livestock, wildlife, and domestic pets in the Williams Creek watershed (**Appendix B** contains a more detailed listing). It should be noted that the loadings shown in **Table 4.4** are total loadings to the land in the creek watershed, and this total load would not be expected to reach the creek (due to decay processes on land). The estimated delivery ratio of coliform to the creek is about 20% (Wanielista, 1997). The numbers of each kind of livestock (USDA, 2003) assigned to each WBID in the county is based on the ratio of (Level 1 agriculture in the WBID/Level 1 agriculture in the county) times the number of livestock in the county. The number of wildlife assigned to each WBID is based on the wildlife densities from Franklin

County (Shields, 2001) and the sum of square miles of "natural areas" (non-urban, non-transportation Level 1 land uses). The domestic pets (dogs, cats, ponies) are assigned based on the number of households in each WBID (USVA, 2004).

4.4 External Loadings to Williams Creek from Downstream Waters Due to Tidal Action

External loadings to Williams Creek from the Braden River due to tidal flow were estimated to be insignificant.

Table 4.4. Average Daily Quantity of Internal Fecal Coliform Loading into Williams Creek –see Appendix B for complete table.*

Nonpoint Source Category	WBID 1901, Williams Creek at Mouth	WBID 1901, Williams Creek at Mouth	Manatee County
	Fecal Coliform Load (CFU/day)	Fecal Coliform Percent of Total Load in WBID 1901	Fecal Coliform Load (CFU/day)
Livestock	2.1159E13	79.569	6.7989E15
Wildlife	2.4512E12	9.218	4.9268E14
Domestic Animals	2.8254E12	10.625	8.5929E14
Septic	1.5696E11	0.590	4.7737E13
TOTAL	**2.6592E13**	**100.00**	**8.1986E15**

* Table is summary of all nonpoint source categories in Appendix B.

Chapter 5: DETERMINATION OF ASSIMILATIVE CAPACITY

5.1 Method Used to Determine Loading Capacity

The methodology (Davis, 2004) used for this TMDL is the "load duration curve." Also known as the "Kansas Approach" because it was developed by the state of Kansas (Stiles, 2003), this method has been well documented in the literature (Cleland, 2002, 2003), with improved modifications used by EPA Region 4 (Davis, 2004). The method relates the pollutant concentration to the flow of the stream to establish the existing loading capacity and the allowable pollutant load (TMDL) under a spectrum of flow conditions, and then determines the maximum allowable pollutant load and load reduction requirement based on the analysis of the critical flow condition. Using this method, it takes four steps to develop the TMDL and establish the required load reduction:

1. Develop the flow duration curve,
2. Develop the load duration curve for both the allowable load and existing loading,
3. Identify the five zones of flow on the duration curves (high, 0-10; moist, 10-40; mid-range, 40-60; dry, 60-90; low, 90-100) and define the critical condition(s), and
4. Establish the needed load reduction by comparing the existing loading with the allowable load under critical conditions (in this case, the 10^{th} to 90^{th} and 10^{th} to 80^{th} percentile flows were used).

5.2 Data Used in the Determination of the TMDL

There are three sampling stations in **WBID 1901** that have historical coliform observations for Williams Creek **(Figure 5.1).** The primary data collector of historical data was the FDEP Tampa District Office. These sites were sampled on a regular basis from March 2002, through October 2002. **Table 5.1** provides a brief statistical overview of the observed data at these sites. Data collected in June, 2003 were also included in the TMDL analysis. **Figure 5.2** shows the observed historical data over time, and **Appendix E** contains the historical observations from the sites. The TMDL will be calculated for the site corresponding to the USGS gage on Williams Creek, which is also the station with the greatest number of sample data.

Table 5.1. Statistical Table of Data Used for Williams Creek (WBID 1901) TMDL Calculations

Parameter	WBID	Total Number of Samples	Geometric Mean of Coliform (N/100mL)	No. of Samples >400/>2400 (N/100mL)	Minimum Concentration (N/100mL)	Maximum Concentration (N/100mL)
Fecal Coliform	1901	21	381.2878	11	30	3500
Total Coliform	1901	21	1538.48	6	410	4200

Figure 5.1. Historical Monitoring Sites in Williams Creek, WBID 1901

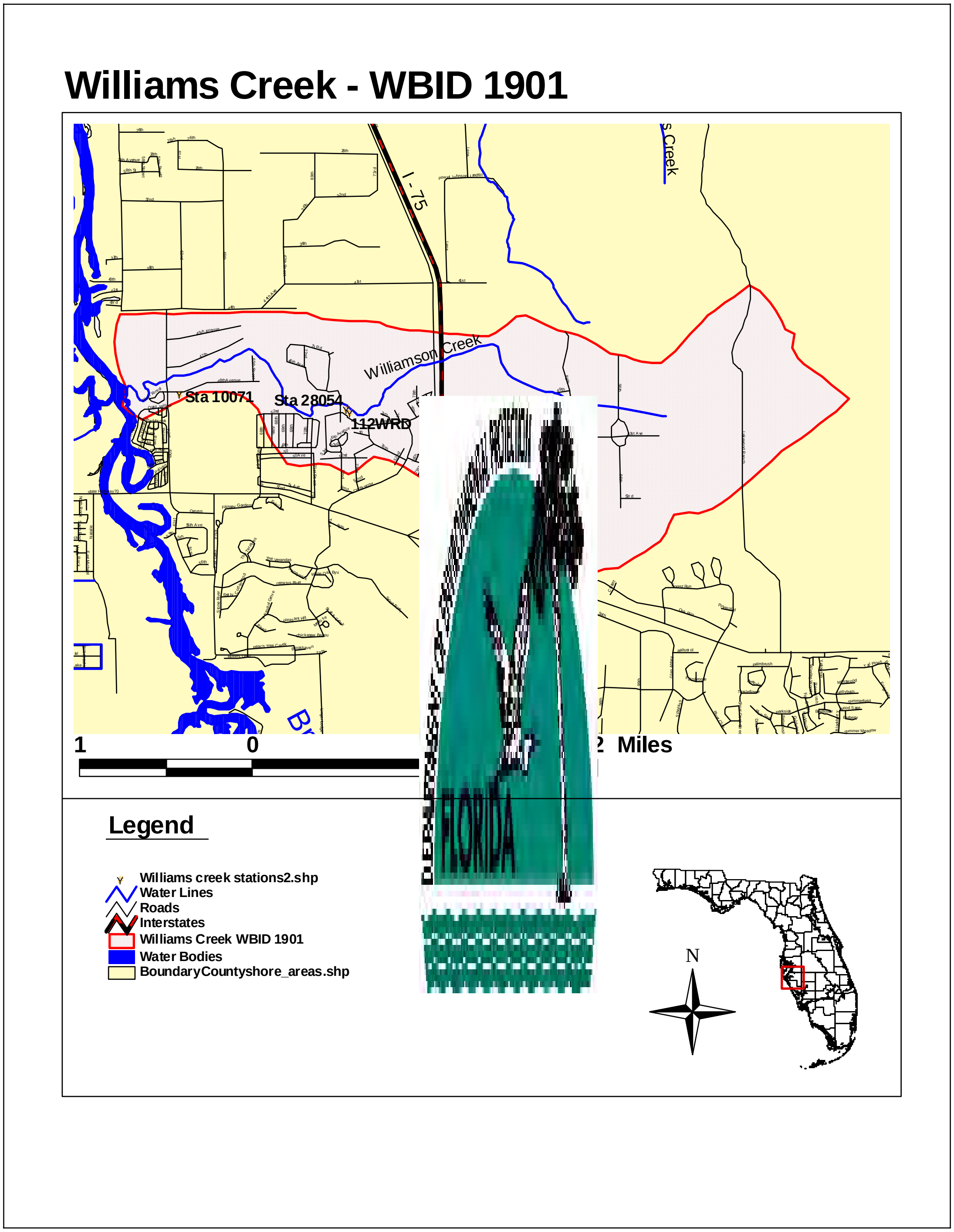
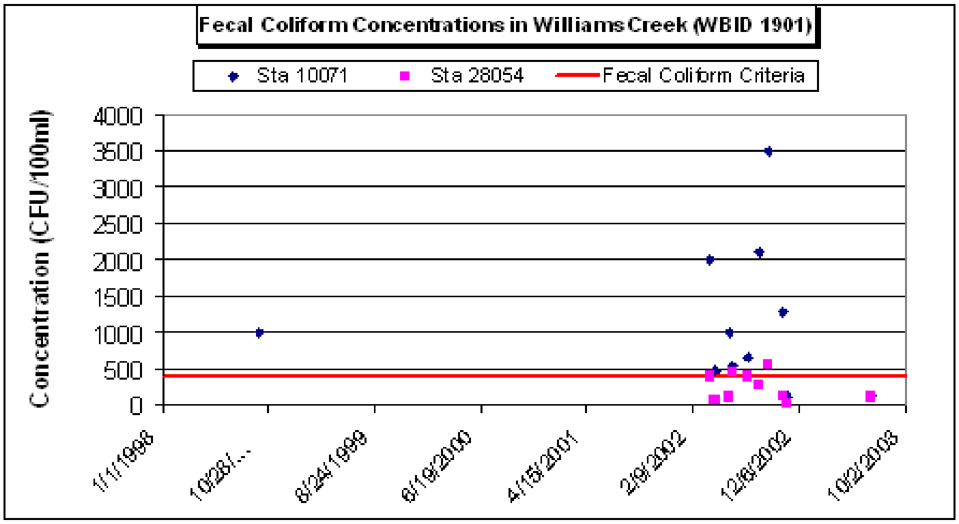
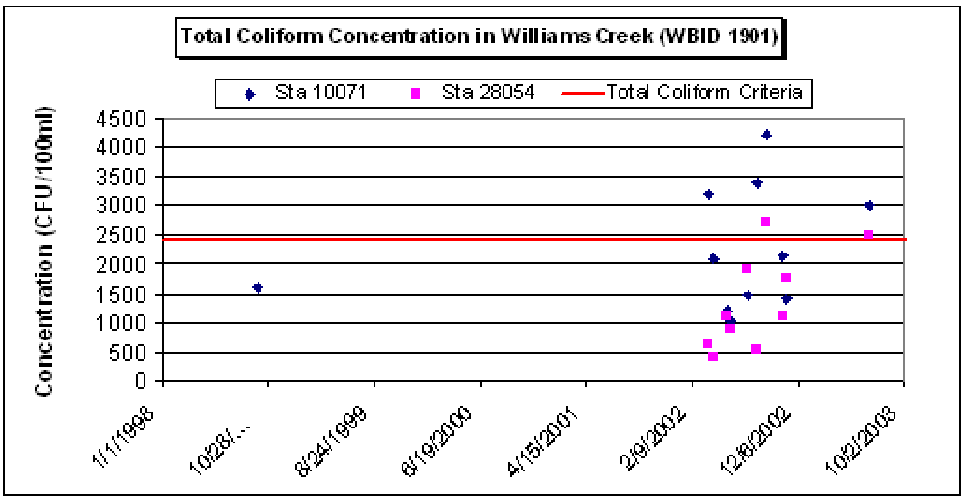


Figure 5.2. Fecal and Total Coliform Data for Williams Creek, WBID 1901





5.3 Determination of Required Percent Reduction

A flow duration curve (Figure 5.4) was developed for **Williams Creek** at the USGS gage site (02300050) based on flow records from the USGS gage at Braden River near Bradenton (USGS 02300032) (see **Appendix E**). The records from the Braden River were used because it was the only nearby USGS gage in operation during the period when coliform data were collected. The flow for the gage site on **Williams Creek** on a given day was obtained by using the MOVE.1 program developed by USGS (Hirsch, 1982), which is based on the following equations:

Let Y= Log Q Williams Creek (02300050) [short term gage], and
X= Log Q Braden River (02300032) [long-term gage].

Then

Y= mean(Y) + (Std. Dev (Y)/Std. Dev (X)) (X - mean (X)), where

Q = the daily average flow as measured in cfs.

Using the flows from this curve, a load duration curve for fecal coliform **(Figure 5.5)** was calculated using the following equation:

(observed flow cfs) x (conversion factor 2.45E07) x (state criterion 400 cfu) = (cfu/day or daily load) (1)

The above equation yields the load duration curve or allowable load curve **(Figure 5.5).** The fecal coliform load (CFU/day) was calculated using Equation 1 (above) by substituting the state criterion with the measured value. Fecal coliform observations were then plotted, noting where the samples were in relation to the allowable load curve (above or below the curve). Those above the curve **(Figure 5.5)** are noted as exceedances to the state criterion and are indicated by pink squares.

Figure 5.4. Flow Duration Curve for **Williams Creek**

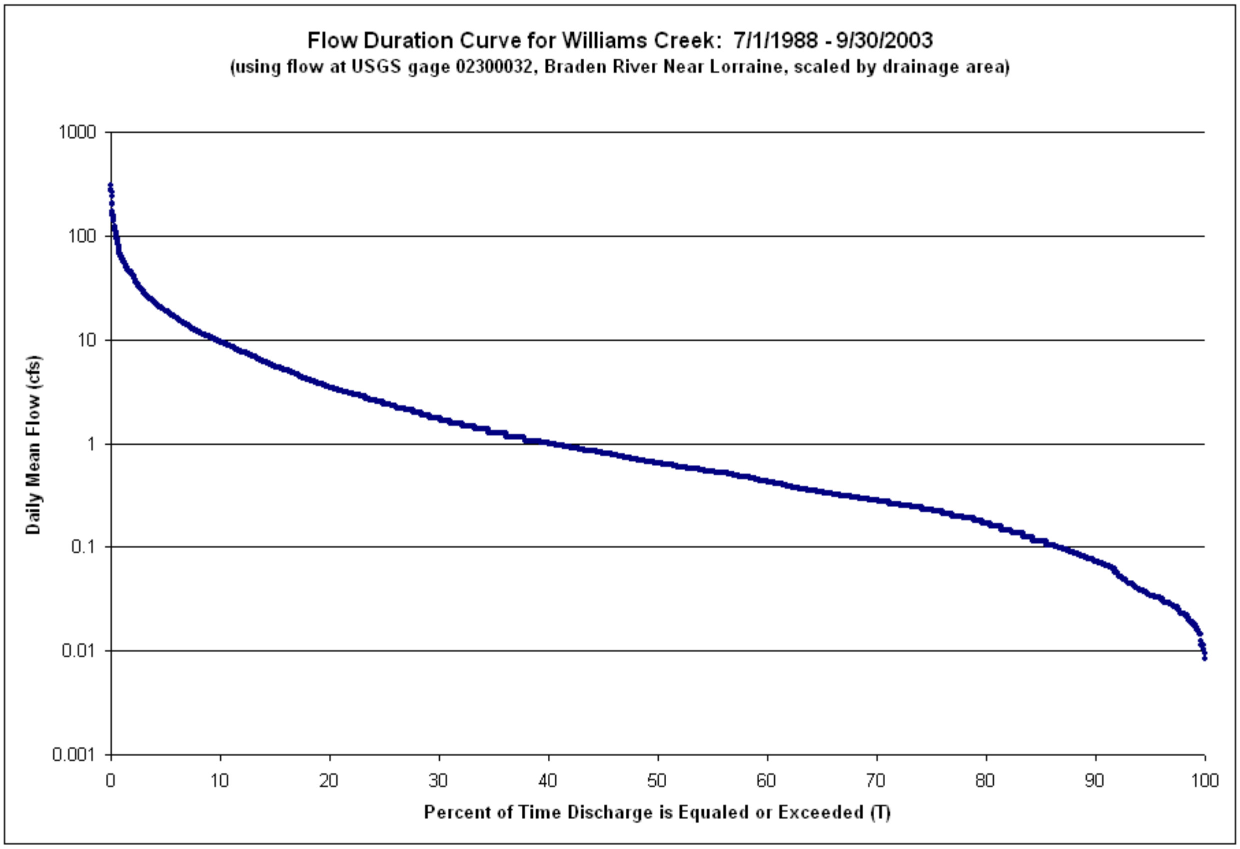


Figure 5.5. Fecal Coliform Observations and Load Duration Curve with Line-of-Best-Fit (Exponential Curve)

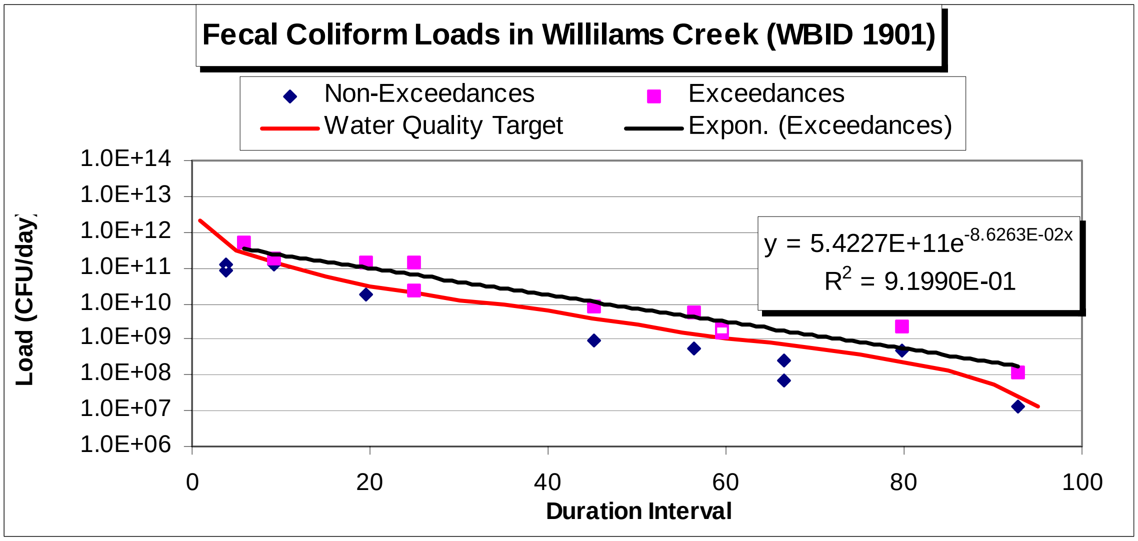

Fecal Coliform Loads in Willilams Creek (WBID 1901)
Non-Exceedances
Exceedances
Water Quality Target
Expon. (Exceedances)
y = 5.4227E+11e-8.6263E-02x
R2 = 9.1990E-01
Load (CFU/day)
1.0E+14
1.0E+13
1.0E+12
1.0E+11
1.0E+10
1.0E+09
1.0E+08
1.0E+07
1.0E+06
0
20
40
60
80
100
Duration Interval

Figure 5.6. Total Coliform Observations and Load Duration Curve with Line-of-Best-Fit (Exponential Curve)

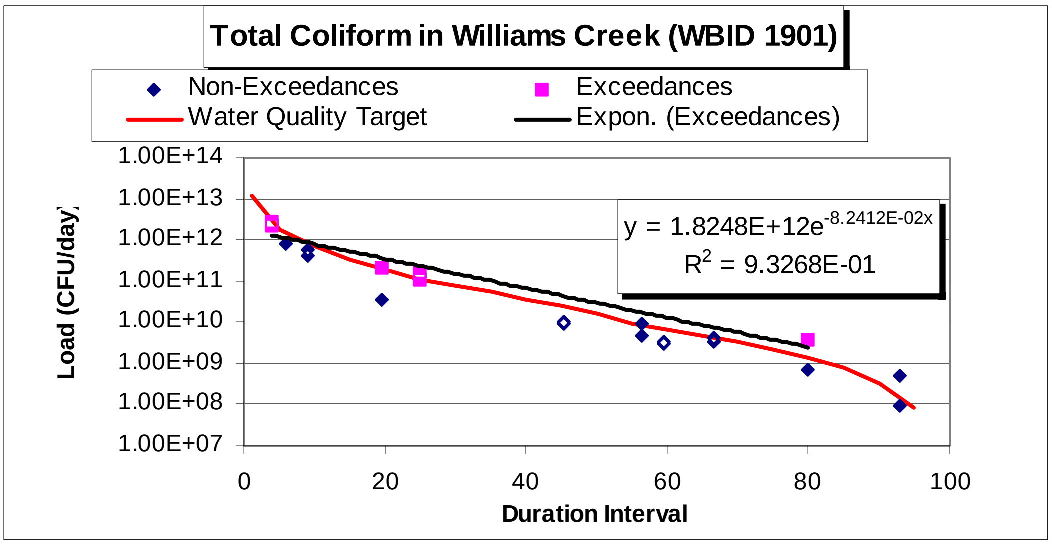
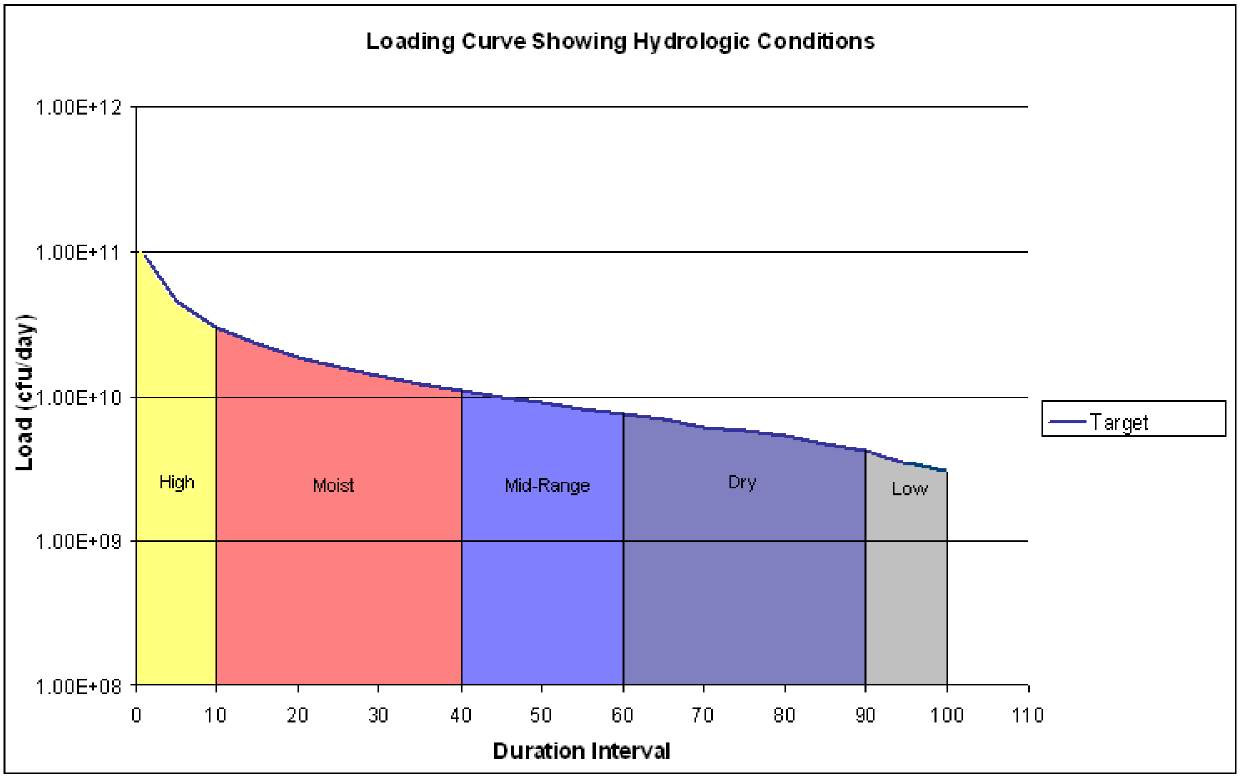


Table 5.3. Observed Data for Calculating Exceedances to the State Criterion for **Williams Creek, WBID 1901**

Station Number	Sample Date	Flow (cfs) using Braden flow scaled by drainage area	Flow Rank (%)	Fecal Coliform (N/100mL)	FC Load (N/day)	Total Coliform (N/100mL)	TC Load (N/day)
21FLTPA 24010071	9/29/98	6.069767442	14.13	1010	1.500E+11	1600	2.376E+11
21FLTPA 24010071	03/27/02	0.100465116	86.56	2000	4.916E+09	3200	7.865E+09
21FLTPA 24010071	04/10/02	0.043953488	93.27	480	5.162E+08	2100	2.258E+09
21FLTPA 24010071	05/22/02	0.029302326	96.72	990	7.097E+08	1200	8.603E+08
21FLTPA 24010071	05/29/02	0.03872093	94.15	550	5.210E+08	1040	9.852E+08
21FLTPA 24010071	07/16/02	12.24418605	7.75	660	1.977E+11	1460	4.374E+11
21FLTPA 24010071	08/12/02	1.255813953	35.99	2100	6.452E+10	3400	1.045E+11
21FLTPA 24010071	09/11/02	6.279069767	13.86	3500	5.377E+11	4200	6.452E+11
21FLTPA 24010071	10/22/02	0.53372093	55.14	1280	1.671E+10	2150	2.807E+10
21FLTPA 24010071	11/04/02	0.53372093	55.16	110	1.436E+09	1400	1.828E+10
21FLTPA 24010071	06/26/03	14.12790698	3.9	140	1.243E+11	3000	2.663E+12
21FLTPA 272711288228054	03/27/02	0.100465116	86.56	400	9.832E+08	610	1.499E+09
21FLTPA 272711288228054	04/10/02	0.043953488	93.27	60	6.452E+07	410	4.409E+08
21FLTPA 272711288228054	05/22/02	0.029302326	96.72	110	7.886E+07	1100	7.886E+08
21FLTPA 272711288228054	05/29/02	0.03872093	94.15	450	4.263E+08	900	8.526E+08
21FLTPA 272711288228054	07/16/02	12.24418605	7.75	400	1.198E+11	1900	5.692E+11
21FLTPA 272711288228054	08/12/02	1.255813953	35.99	280	8.603E+09	540	1.659E+10
21FLTPA 272711288228054	09/11/02	6.279069767	13.86	570	8.757E+10	2700	4.148E+11
21FLTPA 272711288228054	10/22/02	0.53372093	55.14	140	1.828E+09	1120	1.462E+10
21FLTPA 272711288228054	11/04/02	0.53372093	55.16	30	3.917E+08	1750	2.285E+10
21FLTPA 272711288228054	06/26/03	14.12790698	3.9	100	8.875E+10	2500	2.219E+12

Values on the load duration curve can generally be grouped by hydrologic conditions to identify the most likely potential sources. Exceedances falling into the 11th through 40th percentile flows are typically associated with moist conditions when stormwater loads are the most likely source, and exceedances falling in the 61st through 90th percentiles are typically associated with dry conditions when point sources are likely the dominant source **(Figure 5.7** and **Table 5.4).** The plotted data (Figure 5.5 and 5.6) for fecal and total coliforms show that exceedances occur over a wide range of flow conditions.

Figure 5.7. Loading Curve Showing Hydrologic Conditions



To determine the loading capacity, a trend-line of best-fit was applied through the exceedances **(Figure 5.5**). The best-fitting trend line was determined by evaluating different functions until the highest R^2 value was found. In this case, exponential functions were determined to be the best fit, and took the following forms:

(2) Y = (5.4227E+11)*(EXP(-0.086263*X)), where

Y = Fecal Coliform Load (cfu/day) and x= % duration interval

And

(3) Y=(1.8248E+12)*(EXP(-0.082412*X)), where

Y= Total Coliform Load (cfu/day) and x= % duration interval

These exponential functions (Equations 2 and 3) were then used to predict the existing loads by substituting different percentile numbers (10^{th} to 90^{th} and 10^{th} to 80^{th}, incremented by 5 [see **Table 5.4,** Column 1] for x. The results yield ranges of predicted loads within each 5^{th} percentile of the flow record (**Table 5.4**, Columns 3 and 7). The percent reductions in loading needed for compliance with the state criterion for a given 5^{th} percentile of the flow record were then calculated for each estimated load. These calculations involved both the allowable loads and predicted loads previously computed (**Table 5.4**, Columns 2 and 3, respectively, as well as Columns 6 and 7). Using percentile increments of 5 over the flow range with exceedances (ranging from 10 – 90 for fecal coliform, and 10 – 80 for total coliform [see **Table 5.4]**, the needed reductions of daily loads were computed using the following equation:

$$\frac{\text{(predicted load)} - \text{(allowable load)} \times 100\,\%}{\text{(predicted load)}} \qquad \textbf{(4)}$$

The percent reductions in loadings needed for compliance with the state criterion were then calculated as the average percent reductions over the ranges of flows where exceedances occurred, which is 63.2 percent for fecal coliform, and 46.2 percent for total coliform. Similarly, the loading capacities were established as the average allowable loads over the range of flows where exceedances occurred, which is 2.674E+9 CFU/day for fecal coliform, and 2.407E+10 for total coliform.

5.2.3 Critical Conditions/Seasonality

To ensure that this TMDL adequately addresses exceedances during all flow conditions, the TMDL was based on the reduction needed for the critical conditions. Based on the load duration curve, the critical conditions for Williams Creek are the moist to dry flows for both fecal and total coliform. Over these flow conditions, a 63.2 percent reduction in fecal coliform levels is needed to reach the coliform criterion of 400 cfu/100ml, and a 46.2 percent redcuction in total coliform levels is needed to reach the coliform criterion of 2400 cfu/100ml.

Table 5.4. Table for Calculating Needed Reductions and Loading Capacities

% of Days FC Load Exceeded	Allowable FC Load (#col./day)	Predicted FC Load (#col./day)	FC Load Reduction Needed For Compliance (%)	% of Days TC Load Exceeded	Allowable TC Load (#col./day)	Predicted TC Load (#col./day)	TC Load Recuction Needed For Compliance (%)
10	1.192E+11	2.289E+11	47.9%	10	7.149E+11	8.004E+11	10.7%
15	5.617E+10	1.487E+11	62.2%	15	3.370E+11	5.301E+11	36.4%
20	3.156E+10	9.659E+10	67.3%	20	1.894E+11	3.511E+11	46.1%
25	1.908E+10	6.275E+10	69.6%	25	1.145E+11	2.325E+11	50.8%
30	1.279E+10	4.077E+10	68.6%	30	7.673E+10	1.540E+11	50.2%
35	8.808E+09	2.648E+10	66.7%	35	5.285E+10	1.020E+11	48.2%
40	6.008E+09	1.721E+10	65.1%	40	3.605E+10	6.754E+10	46.6%
45	4.012E+09	1.118E+10	64.1%	45	2.407E+10	4.473E+10	46.2%
50	2.674E+09	7.262E+09	63.2%	50	1.605E+10	2.963E+10	45.8%
55	1.593E+09	4.718E+09	66.2%	55	9.559E+09	1.962E+10	51.3%
60	1.076E+09	3.065E+09	64.9%	60	6.459E+09	1.299E+10	50.3%
65	7.829E+08	1.991E+09	60.7%	65	4.697E+09	8.606E+09	45.4%
70	5.474E+08	1.294E+09	57.7%	70	3.285E+09	5.700E+09	42.4%
75	3.641E+08	8.403E+08	56.7%	75	2.185E+09	3.775E+09	42.1%
80	2.234E+08	5.459E+08	59.1%	80	1.340E+09	2.500E+09	46.4%
85	1.360E+08	3.547E+08	61.6%				
90	5.348E+07	2.304E+08	76.8%				
Median	2.674E+09	7.262E+09	63.2%	Median	2.407E+10	4.473E+10	46.2%

Chapter 6: DETERMINATION OF THE TMDL

6.1 Expression and Allocation of the TMDL

The objective of a TMDL is to provide a basis for allocating acceptable loads among all of the known pollutant sources in a watershed so that appropriate control measures can be implemented and water quality standards achieved. A TMDL is expressed as the sum of all point source loads (Waste Load Allocations, or WLAs), nonpoint source loads (Load Allocations, or LAs), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\textbf{TMDL} = \sum \textbf{WLAs} + \sum \textbf{LAs} + \textbf{MOS}$$

As discussed earlier, the WLA is broken out into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program:

$$\textbf{TMDL} \cong \sum \textbf{WLAs}_{\textbf{wastewater}} + \sum \textbf{WLAs}_{\textbf{NPDES Stormwater}} + \sum \textbf{LAs} + \textbf{MOS}$$

It should be noted that the various components of the revised TMDL equation may not sum up to the value of the TMDL because (a) the WLA for NPDES stormwater is typically based on the percent reduction needed for nonpoint sources and is also accounted for within the LA, and (b) TMDL components can be expressed in different terms (for example, the WLA for stormwater is typically expressed as a percent reduction, and the WLA for wastewater is typically expressed as mass per day).

WLAs for stormwater discharges are typically expressed as “percent reduction” because it is very difficult to quantify the loads from MS4s (given the numerous discharge points) and to distinguish loads from MS4s from other nonpoint sources (given the nature of stormwater transport). The permitting of stormwater discharges also differs from the permitting of most wastewater point sources. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities, and instead are required to meet a performance standard of providing treatment to the “maximum extent practical” through the implementation of best management practices (BMPs).

This approach is consistent with federal regulations (40 CFR § 130.2[I]), which state that TMDLs can be expressed in terms of mass per time (e.g., pounds per day), toxicity, or **other appropriate measure**. TMDLs for Williams Creek are expressed in terms of CFU/day, percent reduction and concentration, and represent the maximum daily fecal load the river can assimilate and maintain the fecal coliform criterion **(Table 6.1).** It should be noted that the LA is the same as the TMDL (2.674E+09 CFU/day for fecal coliform and 2.407E+10 CFU/day for total coliform).

Table 6.1. TMDL Components for **Williams Creek**

WBID	Parameter	TMDL (colonies/day)	WLA	WLA	LA Percent Reduction	MOS
			Wastewater (count/100 mL)	NPDES Stormwater Permit Reduction		
1901at gage	Fecal Coliform	2.674E09	Criterion	63.2	63.2	Implicit
1901at gage	Total Coliform	2.407E10	Criterion	46.2	46.2	Implicit

6.2 Load Allocation (LA)

Based on a loading duration curve approach similar to that developed by Kansas (Stiles, 2003), a fecal coliform reduction of 63.2 percent and total coliform reduction of 46.2 percent is needed from nonpoint sources. It should be noted that the LA includes loading from stormwater discharges regulated by the Department and the water management districts that are not part of the NPDES Stormwater Program (see **Appendix A**).

6.3 Wasteload Allocation (WLA)

6.3.1 NPDES Wastewater Discharges

The City of Bradenton and Manatee County's NPDES wastewater permits are required to meet all water quality criteria as a condition of their permit, including all three components of the fecal coliform criterion. This facility, and any future discharge permits issued within or adjacent to the **Williams Creek** watershed, will be required to meet the state Class III criterion for fecal coliform, and therefore will not be allowed to exceed 200 counts/100 mL as a monthly average, 400 more than 10 percent of the time, or 800 counts/100 mL at any given time.

6.3.2 NPDES Stormwater Discharges

The WLA for stormwater discharges is a 63.2 percent reduction in fecal coliform loading and a 46.2 percent reduction in total coliform loading, which are the same percent reductions required for nonpoint sources. It should be noted that any MS4 permittee will only be responsible for reducing the loads associated with stormwater outfalls that it owns or otherwise has responsible control over, and it is not responsible for reducing other nonpoint source loads in its jurisdiction.

6.4 Margin of Safety

Consistent with the recommendations of the Allocation Technical Advisory Committee (Florida Department of Environmental Protection, February 2001), an implicit margin of safety (MOS) was used in the development of this TMDL. An implicit MOS was provided in the TMDL by not allowing any exceedances of the state criterion, even though intermittent natural exceedances of the criterion would be expected and would be taken into account when determining impairment. The TMDL also provides an implicit MOS because it does not take decay/die-off into account. In addition, 400 MPN/100 ml of fecal coliform was used as the water quality target for each and every sampling event instead of setting the criteria such that no more than 10% of the samples exceed 400 MPN/100 ml.

Chapter 7: NEXT STEPS: IMPLEMENTATION PLAN DEVELOPMENT AND BEYOND

7.1 Basin Management Action Plan

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, which will be a component of the Basin Management Action Plan (BMAP) for the Tampa Bay Tributaries –Manatee River Basin. This document will be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.

TMDL development and implementation is an iterative process, and this TMDL will be re-evaluated during the BMAP development process and subsequent watershed management cycles. The Department recognizes that it may be appropriate to revise the TMDL in the future when this additional information has been collected and analyzed.

References

CDM, 1998. Rouge River National Wet Weather Demonstration Project, Wayne County, Michigan, Technical Memorandum, User's Manual: Watershed Management Model Version 4.0 RPO-NPS-TM27.01, September 1998.

Chapra, S. 1997. *Surface Water-Quality Modeling.* McGraw Hill.

Choquette, A.F., Ham, L.K., and Sepulveda, A.A. 1997. *Methods for Estimating Streamflow and Water-Qulity Trends for the Surface-Water Ambient Monitoring Program (SWAMP) Network in Florida.* USGS OFR 97-352.

Cleland, B., 2002. *TMDL Development from the "Bottom Up"- Parts II: Using Duration Curves to Connect the Pieces.* America's Clean Water Foundation.

—. 2003. *TMDL Development from the "Bottom Up"- Part III: Duration Curves and Wet-Wether Assessments.* America's Clean Water Foundation.

COB, 1994. Engineer's Study for Stormwater Demonstration Project No. 2 for Evaluation of Methodologies for Collection, Retention, Treatment, and Reuse of Existing Urban Stormwater S&G project No. 7109-133-01 FDER Contract No. 218 Bradenton, Florida, January 1990, S. Earl Crawley Director of Public Works City of Bradenton and Smith & Gillespie Engineers, Inc.

COB, 2000. City of Bradenton Annual Report for Year 2 for the National Pollutant Discharge Elimination System, Prepared and Submitted by: City of Bradenton Bradenton, Florida John Cumming, April 4, 2000.

COE, 1994. Cedar Hammock (Wares Creek) Draft Detailed Project Report and Environmental assessment Section 205 Flood Control, US Army Corps of Engineers, August 1994.

Davis, M., 2004. *EPA/FDEP Load Duration Curve Protocols.*

DeGrove, B.D., 1984. Manatee River Intensive Survey Data Appendix to FDER Water Quality Technical Series Vol. 1, No. 84.

DeGrove, B.D., 1986. Manatee River Water Quality Based Effluent Limit Documentation, FDER WQTS Vol. 2, No. 100, December, 1986, final..

EPA, 2003. Watershed Based NPDES Permitting Policy Statement From G. Tracy Mehan, Assistant Administrator to Water Directors Regions I – IX, January 07, 2003.

Fernald, E. A., and E. D. Purdum, Eds. 1998. *Water Resources Atlas of Florida.* Tallahassee, Florida: Florida State University, Institute of Science and Public Affairs.

Florida Administrative Code. Chapter 62-302. *Surface Water Quality Standards.*

—. Chapter 62-303. *Identification of Impaired Surface Waters Rule.*

Florida Department of Agriculture and Consumer Services. 2001. Web site http://doacs.state.fl.us/aqua/seas.

—. September 2001. *Florida Aquaculture*. Issue No. 11.

FDER, 1979. Manatee River Intensive Survey Documentation, WQTS, Vol. 1, No. 5, March, 1979.

FDEP

—. 2003. Physical Chemical and Biological Assessment of the Hillsborough Basin TMDL Study, Sampled November 2002 through April 2003, FDEP Bureau of Laboratories, October 2003.

—. December 2000. Biological Assessment of Florida State Hospital Wastewater Treatment Plant, Gadsden County, Florida, NPDES #FL0031402, sampled May 2000.

—. February 1994. Bioassays of Wewahitchka Wastewater Treatment Plant, Wewahitchka, Gulf County, Florida, NPDES #FL0020125, sampled 11/8/93.

—. February 2001. *A Report to the Governor and the Legislature on the Allocation of Total Maximum Daily Loads in Florida.* Tallahassee, Florida: Bureau of Watershed Management.

Florida Department of Health Web site. 2004. Available at http://www.doh.state.fl.us/.

Florida Department of Health. Florida Healthy Beaches Program Web site. 2001. http://apps3doh.state.fl.us/env/beach/webout/default.cfm

Florida Fish and Wildlife Conservation Commission Web site. 2001. http://floridaconservation.org/

Florida Watershed Restoration Act. *Chapter 99-223, Laws of Florida.*

Harwood, V., 2004. Microbial Source Tracking: Tools for Refining Total Maximum Daily Load Assessments, Draft Scope of Work Prepared for FDEP May 27, 2004, Dept. of

Heath, R. C. 1987. *Basic Ground-water Hydrology*. U.S. Geological Survey Water-Supply Paper 2220.

Hesselman, D.M., Seagle, J.H., and Thompson, R.L., 1992. Comprehensive Shellfish Harvesting Area Survey of Sarasota and Roberts Bays, Manatee and Sarasota Counties, Florida, FDNR SEAS July 29, 1992.

Hirsch, R.M., 1982. “A Comparison of Four Streamflow Record Extension Techniques.” *Water Resources Research*, Vol. 18, No. 4, Pages 1081-1088, August 1982.

IFAS, 2003. Manatee County Agriculture Census, http://www.ifas.ufl.edu/extension/info/

Joy, J., 2000. Lower Nooksack River Basin Bacteria Total Maximum Daily Load Evaluation, Washington State Dept. of Ecology Environmental Assessment Proigram Watershed Ecology Section, Olympia, Washington, January 2000.

Matassa, M.R., McEntyre, C.L., and Watson, J.T., 2003. Tennessee Valley Marina and Campground Wastewater Characterization Screening Study, October 2003, Environmental Impacts & Reduction Technologies Public Power Institute.

Palmer, S., 1980. Lower Manatee River Intensive Survey Documentation, WQTS Vol. 1, No. 39, October, 1980.

Roeder, E., 2004. Presentation by Eberhard Roeder FDOH Research Review and Advisory Committee for the Bureau of Onsite Sewage Programs Meeting May 7, 2004. Notes by Patti Sanzone, FDEP.

Roehl, J. W. 1962. Sediment Source Areas, Delivery Ratios, and Influencing Morphological Factors. International Association of Scientific Hydrology. 59: 202-213. Symposium of Bari, October 1-8, 1962.

Rumenik, R. P., and J. W. Grubbs. 1996. *Low-Flow Characteristics of Florida Streams.* U.S. Geological Survey Water Resource Investigations Report 93–4165.

Shields, J. 2001. Annual and Triennial Reevaluation of the Apalachicola Bay Shellfish Harvesting Area (#16), Franklin County From July 1, 1999 through June 30, 2000.

—. 2002. Annual and Triennial Reevaluation of the Apalachicola Bay Shellfish Harvesting Area (#16), Franklin County From July 1, 2001 through June 30, 2002.

Speas, S., 2004. Shanin Speas personal communication on septic tank aerobic treatment units (ATUS).

Stiles, T., 2003. Kansas Dept. of Health & Environment, http: www.kdhe.state.ks.us/tmdl/data.htm.

U.S. Census Bureau Web site. 2004. http://www.census.gov/

—. 2000. *Bacteria Indicator Tool User's Guide.* EPA-823-B-01-003, March 2000.

—. 2001. *Protocol for Developing Pathogen TMDLs.* EPA 841-R-00-002. Washington, D.C.: Office of Water (4503F).

—. 2004. www.epa.gov/region1/assistance/ceitts/wastewater/techs/delta.html.

—. September, 2001. *National Coastal Condition Report*. Prepared by Office of Water and Office of Research and Development.

—. 2003. Census Data http://www.nass.usda.gov/census/census97/highlights/fl/.

—. 2003. Web Site www.floridaaquaculture.com/Sondes/

User's Manual: Watershed Management Model, Version 4.1. 1998. Rouge River National Wet Weather Demonstration Project. Wayne County, Michigan. PRO-NPS-TM27.02.

USVA, 2004. United States Veterinary Association www.avma.org.

Wanielista, M., Kersten, R., and Eaglin, R., 1997. Hydrology: Water Quantity and Quality Control, 2nd Ed. John Wiley & Sons, Inc., New York.

Washington State Department of Health. 2004. Web site at www.doh.wa.gov/wastewater.htm

Appendices

Appendix A: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C.

The rule requires the state's water management districts (WMDs) to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. To date, stormwater PLRGs have been established for Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka. No PLRG has been developed for Newnans Lake at the time this study was conducted.

In 1987, the U.S. Congress established Section 402(p) as part of the federal Clean Water Act Reauthorization. This section of the law amended the scope of the federal NPDES stormwater permitting program to designate certain stormwater discharges as "point sources" of pollution. These stormwater discharges include certain discharges that are associated with industrial activities designated by specific Standard Industrial Classification (SIC) codes, construction sites disturbing five or more acres of land, and master drainage systems of local governments with a population above 100,000, which are better known as municipal separate storm sewer systems (MS4s). However, because the master drainage systems of most local governments in Florida are interconnected, the EPA has implemented Phase 1 of the MS4 permitting program on a countywide basis, which brings in all cities (incorporated areas), Chapter 298 urban water control districts, and the Florida Department of Transportation throughout the fifteen counties meeting the population criteria.

An important difference between the federal and state stormwater permitting programs is that the federal program covers both new and existing discharges, while the state program focuses on new discharges. Additionally, Phase 2 of the NPDES Program will expand the need for these permits to construction sites between one and five acres, and to local governments with as few as 10,000 people. These revised rules require that these additional activities obtain permits by 2003. While these urban stormwater discharges are now technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility similar to other point sources of pollution, such as domestic and industrial wastewater discharges. The Department recently accepted delegation from the EPA for the stormwater part of the NPDES Program. It should be noted that most MS4 permits issued in Florida include a re-opener clause that allows permit revisions to implement TMDLs once they are formally adopted by rule.

Appendix B: Summary of Land Use Loads by Category

Land use Level 1 categories were used as a basis for calculating expected source loads of fecal and total coliform. Human census data from 1990 and 2000 were used for population information, sewage and septic tank percentages and number of households. Septic tank census data were obtained from the Florida Department of Health (FDOH) Web site. Additional information on geographic septic tank distribution was obtained from Department and FDOH reports. In general, septic tank and repair lists are only available by county by year for the past 30 years. The cumulative number of tanks has not been adjusted by the number abandoned, disconnected, or dismantled. Only 1 year of data is available for this information. GIS data linking septic tanks with latitude-longitude are not yet available for each county. These data were used in a TMDL study of Lake Lafayette. The author is pursuing the link of septic tank permits (by street address) to lat-long coordinates to distribute tanks by WBIDs and other basin delineations.

Animal census data were calculated from the American Veterinary Association Web site. Livestock Census Data were obtained from the U.S. Department of Agriculture Web site.

Wildlife census data were obtained from reports by the Florida Fresh Water Fish and Wildlife Commission and Florida Department of Agriculture and Consumer Services, and from previous TMDL studies conducted by the EPA and Georgia EPD.

TABLE 4.4											
WILLIAMS CREEK WBID 1901 FLOWS TO BRADEN RIVER											
AVERAGE DAILY LOADING OF FECAL COLIFORM FROM											
LAND USE LEVEL1			MANATEE COUNTY		REFER-	WBID	1901		MANATEE COUNTY		
			TOTAL		ENCES	TOTAL			TOTAL		
			SQMI	%		SQMI	%		SQMI	%	
1000	URBAN AND BUILT UP		1.0517E+02	14.18485		3.4580E-01	9.706394206		1.0517E+02	1.4185E+01	
2000	AGRICULTURE		3.1377E+02	42.31914		1.6616E+00	46.64009431		3.1377E+02	4.2319E+01	
3000	RANGELAND		9.6265E+01	12.9837		1.5480E-01	4.345141189		9.6265E+01	1.2984E+01	
4000	UPLAND FORESTS		7.7208E+01	10.41338		7.1580E-01	20.09206759		7.7208E+01	1.0413E+01	
5000	WATER		2.7294E+01	3.68123		5.3900E-02	1.512939988		2.7294E+01	3.6812E+00	
6000	WETLANDS		1.1145E+02	15.03187		5.2520E-01	14.74204233		1.1145E+02	1.5032E+01	
7000	BARREN LAND		7.6800E-01	0.103584		7.0000E-03	0.196485713		7.6800E-01	1.0358E-01	
8000	TRANSPORTATION AND UTILITIES		9.5069E+00	1.28224		9.8500E-02	2.764834671		9.5069E+00	1.2822E+00	
	TOTAL LAND		7.1414E+02	96.31877		3.5087E+00	98.48706001		7.1414E+02	9.6319E+01	
	TOTAL LAND+WATER		7.4143E+02	100		3.5626E+00	100		7.4143E+02	1.0000E+02	
	TOTAL CENSUS 2000		544								
	URBAN RATIO WBID/COUNTY		1			3.2880E-03					
	AGRICULTURE RATIO WBID/COUNTY					5.2957E-03					
	NATURAL RATIO WBID/COUNTY					4.9753E-03					
	TOTAL SEPTIC TANKS THRU 2000		3.8482E+04			1.2653E+02			3.8482E+04		
	TOTAL REPAIRS THRU 2000		7.8400E+02			2.5778E+00			7.8400E+02		
	TOTAL FAILURES		7.6964E+02			2.5306E+00			7.6964E+02		
	TOTAL HOUSEHOLDS		1.3813E+05			4.5416E+02			1.3813E+05		
	TOTAL HOUSEBOATS										
	TOTAL 1990 PUBLIC SEWER		102788			3.3797E+02			102788		
	TOTAL 1990 SEPTIC		12105			3.9801E+01			12105		
	TOTAL 1990 OTHER		352			1.1574E+00			352		
	TOTAL POPULATION		2.6400E+05			8.6804E+02			2.6400E+05		
LIVESTOCK, WILDLIFE, AND DOMESTIC ANIMALS					REFER-	WBID	1901		MANATEE COUNTY		
					ENCES				AT MOUTH		
ANIMAL TYPE	FC PRODUCED	ANIMALS	COUNTY	ANIMAL		DA1	NDA1	LFC1	DA3	NDA3	LFC3
	LFC	PER COUNTY	AREA	DENSITY							
	CTS/ANIMAL/DAY		SQMI	N/SQMI		SQMI	N	CTS/DAY	SQMI	N	CTS/DAY
			7.41E+02								
LIVESTOCK											
CATTLE AND CALVES INVENTORY							3.2800E+02			61937	
CATTLE AND CALVES SOLD	1.04E+11						1.4275E+02	1.4846E+13		26956	2.8034E+15
DAIRY CATTLE INVENTORY	1.01E+11		741.43		C		2.5996E+01	2.6204E+12		4909	4.9483E+14
BEEF CATTLE INVENTORY	1.04E+11		741.43		C		1.7763E+02	1.8474E+13		33543	3.4885E+15
SHEEP AND LAMBS INVENTORY	1.20E+10		741.43		C		9.2674E-01	1.1121E+10		175	2.1000E+12
SHEEP AND LAMBS SOLD	1.20E+10						0.0000E+00	0.0000E+00			0.0000E+00
HORSES AND PONIES INVENTORY	4.20E+08		741.43		C		8.2877E+00	3.4808E+09		1565	6.5730E+11
HORSES AND PONIES SOLD	4.20E+08						1.0644E+00	4.4706E+08		201	8.4420E+10
MULES, BURROS, AND DONKEYS	4.20E+08		741.43		C,E		1.9064E-01	8.0070E+07		36	1.5120E+10
MULES, BURROS, AND DONKEYS	4.20E+08						0.0000E+00	0.0000E+00			0.0000E+00
LLAMAS (~SHEEP)	1.20E+10		741.43		C,E		4.1836E-01	5.0203E+09		79	9.4800E+11
BISON (~BEEF CATTLE)	1.04E+11		741.43		C,E		0.0000E+00	0.0000E+00			0.0000E+00
DEER	5.00E+08		741.43		C,E		0.0000E+00	0.0000E+00			0.0000E+00
ELK	5.00E+08		741.43		C,E		0.0000E+00	0.0000E+00			0.0000E+00
GOATS, ALL (~SHEEP) INVENTORY	1.20E+10		741.43		C,E		6.8844E-01	8.2612E+09		130	1.5600E+12
GOATS, ALL (~SHEEP) SOLD	1.20E+10						3.0715E-01	3.6858E+09		58	6.9600E+11
HOGS AND PIGS INVENTORY	1.08E+10		741.43		C		9.7440E-01	1.0524E+10		184	1.9872E+12
HOGS AND PIGS SOLD	1.08E+10						1.5516E+00	1.6758E+10		293	3.1644E+12
LAYER CHICKENS INVENTORY	1.40E+08		741.43		C		1.9705E+01	2.7587E+09		3721	5.2094E+11
LAYER CHICKENS SOLD	1.40E+08						0.0000E+00	0.0000E+00			0.0000E+00
BROILERS INVENTORY	1.40E+08		741.43		C		6.8844E-02	9.6381E+06		13	1.8200E+09
BROILERS SOLD	1.40E+08						0.0000E+00	0.0000E+00			0.0000E+00
TURKEYS INVENTORY	9.50E+07		741.43		C		2.3830E-01	2.2639E+07		45	4.2750E+09
TURKEYS SOLD	9.50E+07						0.0000E+00	0.0000E+00			0.0000E+00
DUCKS INVENTORY	2.50E+09		741.43		C		2.8597E-01	7.1491E+08		54	1.3500E+11
DUCKS SOLD	2.50E+09						0.0000E+00	0.0000E+00			0.0000E+00
GEESE INVENTORY	4.90E+10		741.43		C		3.1774E-02	1.5569E+09		6	2.9400E+11
GEESE SOLD	4.90E+10						0.0000E+00	0.0000E+00			0.0000E+00
EMUS (~GEESE)	4.90E+10		741.43		C,E		0.0000E+00	0.0000E+00			0.0000E+00
OSTRICHES (~GEESE)	4.90E+10		741.43		C,E		0.0000E+00	0.0000E+00			0.0000E+00
PHEASANTS (~GEESE) INVENTOR	4.90E+10		741.43		C,E		0.0000E+00	0.0000E+00			0.0000E+00
PHEASANTS (~GEESE) SOLD	4.90E+10						0.0000E+00	0.0000E+00			0.0000E+00
PIGEONS OR SQUAB INVENTORY	1.60E+08		741.43		C		0	0.0000E+00			0.0000E+00
PIGEONS OR SQUAB SOLD	1.60E+08						0	0.0000E+00			0.0000E+00
QUAIL (~PIGEON)	1.60E+08		741.43		C		0	0.0000E+00			0.0000E+00
OTHER			741.43		C		0	0.0000E+00			0.0000E+00
RABBITS INVENTORY			741.43		C		0	0.0000E+00			0.0000E+00
RABBITS SOLD							0	0.0000E+00			0.0000E+00
TOTAL LIVESTOCK			741.43		C			2.1159E+13			6.7989E+15
			741.43		C						
WILDLIFE			741.43		C						
ALLIGATORS			741.43		C						0.0000E+00
BLACK BEARS			741.43		C						0.0000E+00
RACCOONS	1.25E+08		741.43		C						0.0000E+00
BEAVERS	2.50E+08		741.43		C						0.0000E+00
DEER	5.00E+08		741.43	22.16	CHI		6.9102E+01	3.4551E+10		1.3889E+04	6.9444E+12
DOLPHIN, PORPOISE,MANATEE			544		C						0.0000E+00
WATERFOWL	4.90E+10		741.43	12.4	CHI		3.8667E+01	1.8947E+12		7.7717E+03	3.8081E+14
WILD PIGS	1.08E+10		741.43	15.5	CHI		4.8334E+01	5.2200E+11		9.7146E+03	1.0492E+14
			741.43		C						0.0000E+00
TOTAL WILDLIFE			741.43		C			2.45123E+12			4.9268E+14
			741.43		C						
DOMESTIC ANIMALS			741.43		C						
DOGS	5.00E+09		741.43	0.58*HH	F		2.6341E+02	1.3171E+12		8.0114E+04	4.0057E+14
CATS	5.00E+09		741.43	0.66*HH	F		2.9975E+02	1.4987E+12		9.1164E+04	4.5582E+14
HORSES AND PONIES-PETS	4.20E+08		741.43	0.05*HH	F		2.2708E+01	9.5374E+09		6.9064E+03	2.9007E+12
TOTAL DOMESTIC			741.43					2.8254E+12			8.5929E+14
			741.43								
SEPTIC- HUMAN IMPACTS			741.43								
HUMAN	2.00E+09	11057	741.43								0.0000E+00
SEWER LINE LEAKS	6.89E+09		741.43					1.3953E+11			4.2435E+13
HOUSEBOATS-NONMARINA	2.00E+09		741.43		C						0.0000E+00
BOATS-MARINA SLIPS	2.00E+09		741.43								0.0000E+00
SEPTIC TANKS FAILED	6.89E+09		741.43				2.5306E+00	1.7433E+10		7.6964E+02	5.3020E+12
SEPTIC TANKS NORMAL			741.43								0.0000E+00
SEPTIC TANKS -ATU	2.76E+08		741.43								0.0000E+00
TOTAL SEPTIC			741.43					1.5696E+11			4.7737E+13
AQUACULTURE											
FISH FARMS											0.0000E+00
OYSTER HOUSES											0.0000E+00
TOTAL AQUACULTURE											0.0000E+00
TOTAL								2.6592E+13			8.1986E+15
REFERENCES											
A	USDA 2002 CENSUS, NOTE A-D INDICATES CONFIDENTIAL DATA NOT AVAILABLE AT										
B	ASSUME 1 ANIMAL PER HOUSEHOLD* 7180 HOUSING UNITS=7180										
C	EPA, 2001. PROTOCOL FOR DEVELOPING PATHOGEN TMDLS EPA 841-R-00-002										
D	ASAE, 1998. HTTP://ASAE.ORG										
E	ESTIMATED FROM SIMILAR ANIMALS										
F	WWW.AVMA.ORG VETERINARY STATISTICS 2002 US PET OWNERSHIP- DOGS=0.58*HOUSEHOLDS, CATS=0.66*HH, HORSES=0.05*HH										
G	SPEAS, 2004 RANGE OF 500 CFU-1900 CFU/100 ML OR 96% REMOVAL, USE ONE ATU=0.04*6.89E09 CFU/DAY										
H	WWW.EPA.GOV/REGION1/ASSISTANCE/CEITTS/WASTEWATER/TECHS/DELTA.HTML										
I	SHIELDS, 2001. ANNUAL REEVALUATION OF APALACHICOLA BAY HARVESTING AREA #16										

Appendix C: Summary of Permitted Point Sources

Facility	Permit Number	Disposal Method	Permitted Flow (mgd)
Chula Vista Mobil Home Park Wastewater Treatment Plant	FLA012210	LA	0.0250
Hide-A-Way Campground	FLA012133	LA	0.0300
Hillsborough County Rest Area I-75N	FLA012609	LA	0.0400
Little Manatee Isles Mobil Home Park	FLA012203	LA	0.0300
Little Manatee River Mobil Home Park	FLA012170	LA	0.0400
Neptune Mv	FLA012260	LA	0.0265
River Oaks Rv Resort	FLA012231	LA	0.0100
Riverside Club Wastewater Treatment Plant	FLA012169	LA	0.0600
Tampa South RV Resort	FLA012264	LA	0.0121
Little Manatee River Industrial Facilities			
Diggers Concrete, Inc.	FLA012340	N	Report
Imc Phosphates Co. - Four Corners Mine	FL0036412	SW	Report
Jh Williams Oil Company - Chevron/Hardees	FLA178781	N	Report
Rainbow Car Wash	FLA181404	N	Report
Tomatoes of Ruskin, Inc.	FLA177351	N	Report
Manatee River Domestic Facilities			
City of Bradenton WWTP	FL0021369	LA/SW	9.0000
Florida Power & Light Manatee Wastewater Treatment Plant	FLA012625	LA	0.0050
Lake Manatee Recreation Area Wastewater Treatment Plant	FLA012654	LA	0.0050

Manatee County Southeast Regional Wastewater Treatment Plant	FLA012618	LA	5.4000
Winggate Creek Mine Wastewater Treatment Plant	FLA012622	LA	0.0050
Manatee River Industrial Facilities			
F.P.L. Manatee Service Garage	FLA017060	N	Report
Florida Power & Lihgt Co. - Manatee Plant	FL0032174	LA/SW	Report
Miami Valley Concrete Co. - Ellenton Plant	FL0126411	SW	Report
Nu-Gulf Industries, Inc. - Wingate Creek Mine	FL0032522	LA/SW	Report
Singeltary - Ellenton - 17th St. East	FLA012642	N	Report
SMR Aggregates, Inc. (fka Quality Aggregates, Inc.)	FL0043354	SW	Report
Taylor & Fulton Packing House	FLA177920	N	Report
Tropicana Products, Inc.	FL0000043	SW	0.8000
West Coast Tomato, Inc.	FLA012644	N	Report

Appendix D: Summary of Williams Creek Data used to calculate TMDL.

Sensitivity of TMDL results using the gage on Braden River to estimate flows on Williams Creek

Fecal Coliform Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (%)	Fecal Coliform (CFU/100mL)	Fecal Coliform Load (CFU/day)
21FLTPA 272711288228054	11/4/2002	1128	0.289	49.6%	49.6	30	2.12E+08
21FLTPA 272711288228054	4/10/2002	1150	0.008	87.5%	87.5	60	1.23E+07
21FLTPA 272711288228054	6/26/2003		36.275	3.9%	3.9	100	8.88E+10
21FLTPA 24010071	11/4/2002	1115	0.289	49.6%	49.6	110	7.78E+08
21FLTPA 272711288228054	5/22/2002	855	0.005	90.9%	90.9	110	1.27E+07
21FLTPA 272711288228054	10/22/2002	1110	0.289	49.6%	49.6	140	9.91E+08
21FLTPA 24010071	6/26/2003		36.275	3.9%	3.9	140	1.24E+11
21FLTPA 272711288228054	8/12/2002	935	0.972	34.3%	34.3	280	6.66E+09
21FLTPA 272711288228054	3/27/2002	1020	0.027	78.8%	78.8	400	2.65E+08
21FLTPA 272711288228054	7/16/2002	1245	24.516	6.1%	6.1	400	2.40E+11
21FLTPA 24010071	7/16/2002	1230	24.516	6.1%	6.1	660	3.96E+11
21FLTPA 272711288228054	9/11/2002	1120	9.515	11.8%	11.8	570	1.33E+11
21FLTPA 24010071	9/11/2002	1110	9.515	11.8%	11.8	3500	8.15E+11
21FLTPA 24010071	9/29/1998	955	9.069	12.1%	12.1	1010	2.24E+11
21FLTPA 24010071	8/12/2002	955	0.972	34.3%	34.3	2100	5.00E+10
21FLTPA 24010071	10/22/2002	1055	0.289	49.6%	49.6	1280	9.06E+09
21FLTPA 24010071	3/27/2002	1105	0.027	78.8%	78.8	2000	1.33E+09
21FLTPA 24010071	4/10/2002	1120	0.008	87.5%	87.5	480	9.87E+07
21FLTPA 272711288228054	5/29/2002	1210	0.007	88.3%	88.3	450	7.73E+07
21FLTPA 24010071	5/29/2002	1155	0.007	88.3%	88.3	550	9.45E+07
21FLTPA 24010071	5/22/2002	905	0.005	90.9%	90.9	990	1.15E+08

Note: above flows and loads based on flows estimated using MOVE.1 and Braden River gage

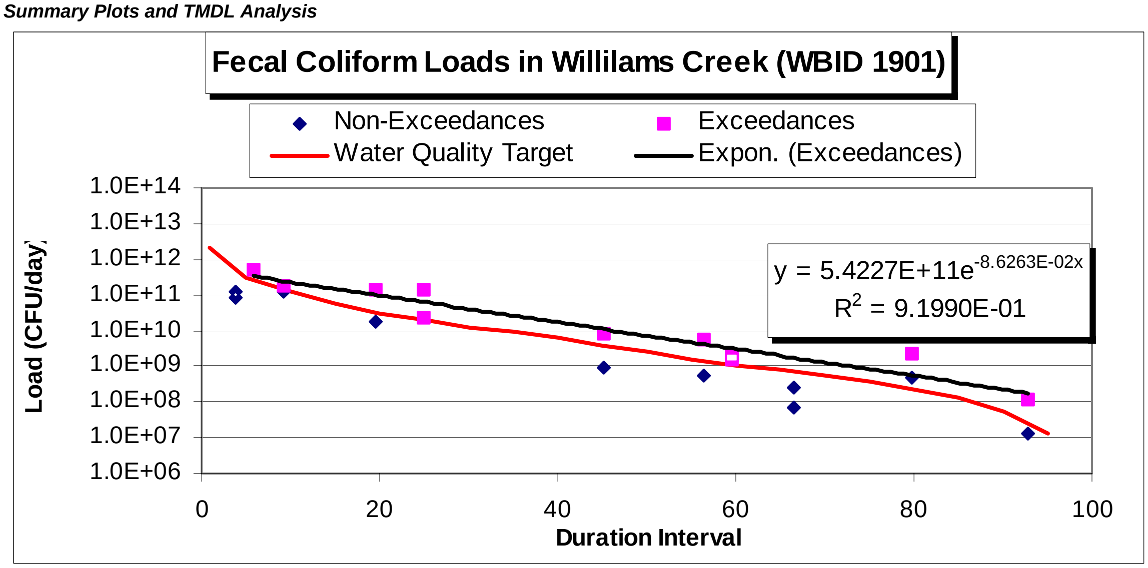
Total Coliform Station	Sample Date	Sample Time	Flow (cfs)	Flow Rank	Flow Rank (%)	Total Coliform (CFU/100mL)	Total Coliform Load (CFU/day)
21FLTPA 272711288228054	4/10/2002	1150	0.008	87.5%	87.5	410	8.43E+07
21FLTPA 272711288228054	8/12/2002	935	0.972	34.3%	34.3	540	1.28E+10
21FLTPA 272711288228054	3/27/2002	1020	0.027	78.8%	78.8	610	4.05E+08
21FLTPA 272711288228054	5/29/2002	1210	0.007	88.3%	88.3	900	1.55E+08
21FLTPA 24010071	5/29/2002	1155	0.007	88.3%	88.3	1040	1.79E+08
21FLTPA 272711288228054	5/22/2002	855	0.005	90.9%	90.9	1100	1.27E+08
21FLTPA 272711288228054	10/22/2002	1110	0.289	49.6%	49.6	1120	7.92E+09
21FLTPA 24010071	5/22/2002	905	0.005	90.9%	90.9	1200	1.39E+08
21FLTPA 24010071	11/4/2002	1115	0.289	49.6%	49.6	1400	9.91E+09
21FLTPA 24010071	7/16/2002	1230	24.516	6.1%	6.1	1460	8.76E+11
21FLTPA 24010071	9/29/1998	955	9.069	12.1%	12.1	1600	3.55E+11
21FLTPA 272711288228054	11/4/2002	1128	0.289	49.6%	49.6	1750	1.24E+10
21FLTPA 272711288228054	7/16/2002	1245	24.516	6.1%	6.1	1900	1.14E+12
21FLTPA 24010071	4/10/2002	1120	0.008	87.5%	87.5	2100	4.32E+08
21FLTPA 24010071	10/22/2002	1055	0.289	49.6%	49.6	2150	1.52E+10
21FLTPA 272711288228054	6/26/2003		36.275	3.9%	3.9	2500	2.22E+12
21FLTPA 24010071	6/26/2003		36.275	3.9%	3.9	3000	2.66E+12
21FLTPA 272711288228054	9/11/2002	1120	9.515	11.8%	11.8	2700	6.29E+11
21FLTPA 24010071	9/11/2002	1110	9.515	11.8%	11.8	4200	9.78E+11
21FLTPA 24010071	8/12/2002	955	0.972	34.3%	34.3	3400	8.09E+10
21FLTPA 24010071	3/27/2002	1105	0.027	78.8%	78.8	3200	2.12E+09

Note: above flows and loads based on flows estimated using MOVE.1 and Braden River gage

Water Quality Target Analysis						
		Peak to Low				
Flow Rank	Flow Rank (%)	cfs		FC Target Load	TC Target Load	
0.077%		2051.880		2.01E+13	1.20E+14	
0.100%		1012.599		9.91E+12	5.95E+13	
0.274%		625.199		6.12E+12	3.67E+13	
1%	1	205.858		2.01E+12	1.21E+13	
5%	5	30.344		2.97E+11	1.78E+12	
10%	10	12.175		1.19E+11	7.15E+11	
15%	15	5.740		5.62E+10	3.37E+11	
20%	20	3.225		3.16E+10	1.89E+11	
25%	25	1.950		1.91E+10	1.15E+11	
30%	30	1.307		1.28E+10	7.67E+10	
35%	35	0.900		8.81E+09	5.28E+10	
40%	40	0.614		6.01E+09	3.60E+10	
45%	45	0.410		4.01E+09	2.41E+10	
50%	50	0.273		2.67E+09	1.60E+10	
55%	55	0.163		1.59E+09	9.56E+09	
60%	60	0.110		1.08E+09	6.46E+09	
65%	65	0.080		7.83E+08	4.70E+09	
70%	70	0.056		5.47E+08	3.28E+09	
75%	75	0.037		3.64E+08	2.18E+09	
80%	80	0.023		2.23E+08	1.34E+09	
85%	85	0.014		1.36E+08	8.16E+08	
90%	90	0.005		5.35E+07	3.21E+08	
95%	95	0.001		1.39E+07	8.36E+07	
99%	99	0.000		0.00E+00	0.00E+00	
100%	100	0.000		0.00E+00	0.00E+00	
10.7%		11.106		1.09E+11	6.52E+11	

	Stream name:	Williams Creek				
	1-day	*High (0 - 10)*	*Moist (10 - 40)*	*Mid (40 - 60)*	*Dry (60-90)*	*Low (90-100)*
Fecal Coliform Loads	6.12E+12	2.97E+11	1.91E+10	2.67E+09	3.64E+08	1.39E+07
Total Coliform Loads	3.67E+13	1.78E+12	1.15E+11	1.60E+10	2.18E+09	8.36E+07

Summary Plots and TMDL Analysis



Zone Approach for fecal coliform:

a) Existing Loads expressed as cfu/day (average violation in each zone); TMDL is midpoint in range

	High (0-10)	Moist (10-40)	Mid-Range (40-60)	Dry (60-90)	Low (90-100)
TMDL	2.97E+11	1.91E+10	2.67E+09	3.64E+08	1.39E+07
Existing	3.59E+11	9.89E+10	4.31E+09	2.41E+09	1.12E+08
% Redux	17.4%	80.7%	38.0%	84.9%	87.6%

b) Regression Line approach to estimating TMDL:

Exponential Line best defines violations

y = 5.4227E+11e-0.086263x

R2 = 0.91990

Interval	**TMDL**	**Existing**	**% Reduction**
10	1.19E+11	2.29E+11	47.9%
15	5.62E+10	1.49E+11	62.2%
20	3.16E+10	9.66E+10	67.3%
25	1.91E+10	6.28E+10	69.6%
30	1.28E+10	4.08E+10	68.6%
35	8.81E+09	2.65E+10	66.7%
40	6.01E+09	1.72E+10	65.1%
45	4.01E+09	1.12E+10	64.1%
50	2.67E+09	7.26E+09	63.2%
55	1.59E+09	4.72E+09	66.2%
60	1.08E+09	3.06E+09	64.9%
65	7.83E+08	1.99E+09	60.7%
70	5.47E+08	1.29E+09	57.7%
75	3.64E+08	8.40E+08	56.7%
80	2.23E+08	5.46E+08	59.1%
85	1.36E+08	3.55E+08	61.6%
90	5.35E+07	2.30E+08	76.8%
95	1.39E+07	1.50E+08	90.7%

median regression line values between 10th and 90th interval (where most violations occur):

TMDL = 2.67E+09 CFU/day

Existing = 7.26E+09 CFU/day

Reduction = 63.2%

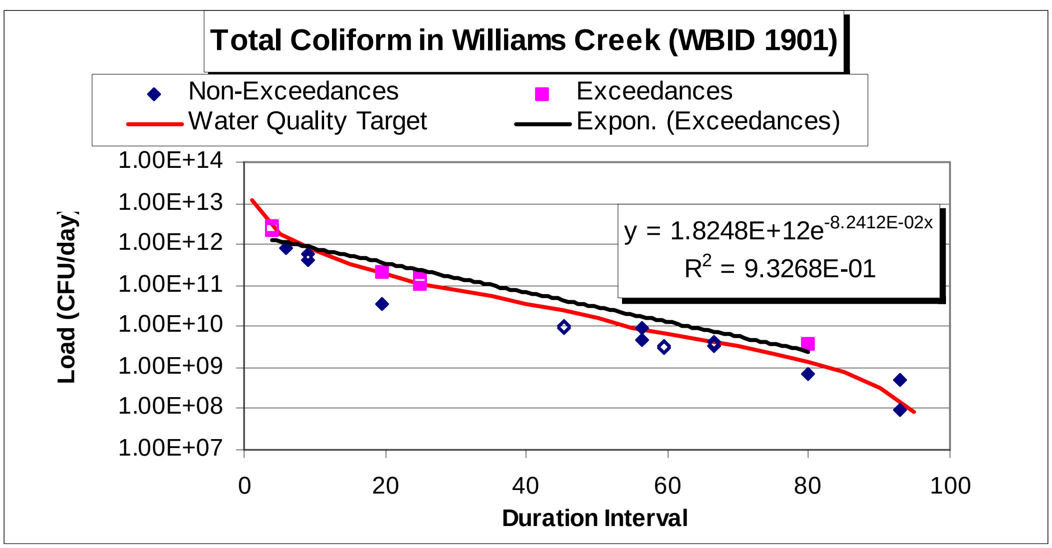
TMDL Components:

WLA = n/a for continuous sources; **PHASE II MS4 Area**

LA = TMDL

TMDL = 2.67E+09 CFU/day (based on regression line)

Reduction: 63.2%



Zone Approach for total coliform:

a) Existing Loads expressed as cfu/day (average violation in each zone); TMDL is midpoint in range

	High (0-10)	Moist (10-40)	Mid-Range (40-60)	Dry (60-90)	Low (90-100)
TMDL	1.78E+12	1.15E+11	1.60E+10	2.18E+09	8.36E+07
Existing	2.44E+12	1.64E+11		3.86E+09	
Reduction	27.0%	30.3%		43.3%	

b) Regression Line approach to estimating TMDL:

Exponential Line best defines violations

y = 1.8248E+12e-0.082412x

R2 = 0.93268

Interval	**TMDL**	**Existing**	**% Reduction**
10	7.15E+11	8.00E+11	10.7%
15	3.37E+11	5.30E+11	36.4%
20	1.89E+11	3.51E+11	46.1%
25	1.15E+11	2.33E+11	50.8%
30	7.67E+10	1.54E+11	50.2%
35	5.28E+10	1.02E+11	48.2%
40	3.60E+10	6.75E+10	46.6%
45	2.41E+10	4.47E+10	46.2%
50	1.60E+10	2.96E+10	45.8%
55	9.56E+09	1.96E+10	51.3%
60	6.46E+09	1.30E+10	50.3%
65	4.70E+09	8.61E+09	45.4%
70	3.28E+09	5.70E+09	42.4%
75	2.18E+09	3.77E+09	42.1%
80	1.34E+09	2.50E+09	46.4%
85	8.16E+08	1.66E+09	50.7%
90	3.21E+08	1.10E+09	70.7%
95	8.36E+07	7.26E+08	88.5%

median regression line values between 10th and 80th interval (where most violations occur):

TMDL = 2.41E+10 CFU/day

Existing = 4.47E+10 CFU/day

Reduction = 46.2%

TMDL Components:

WLA = n/a for continuous sources; **PHASE II MS4 Area**

LA = TMDL

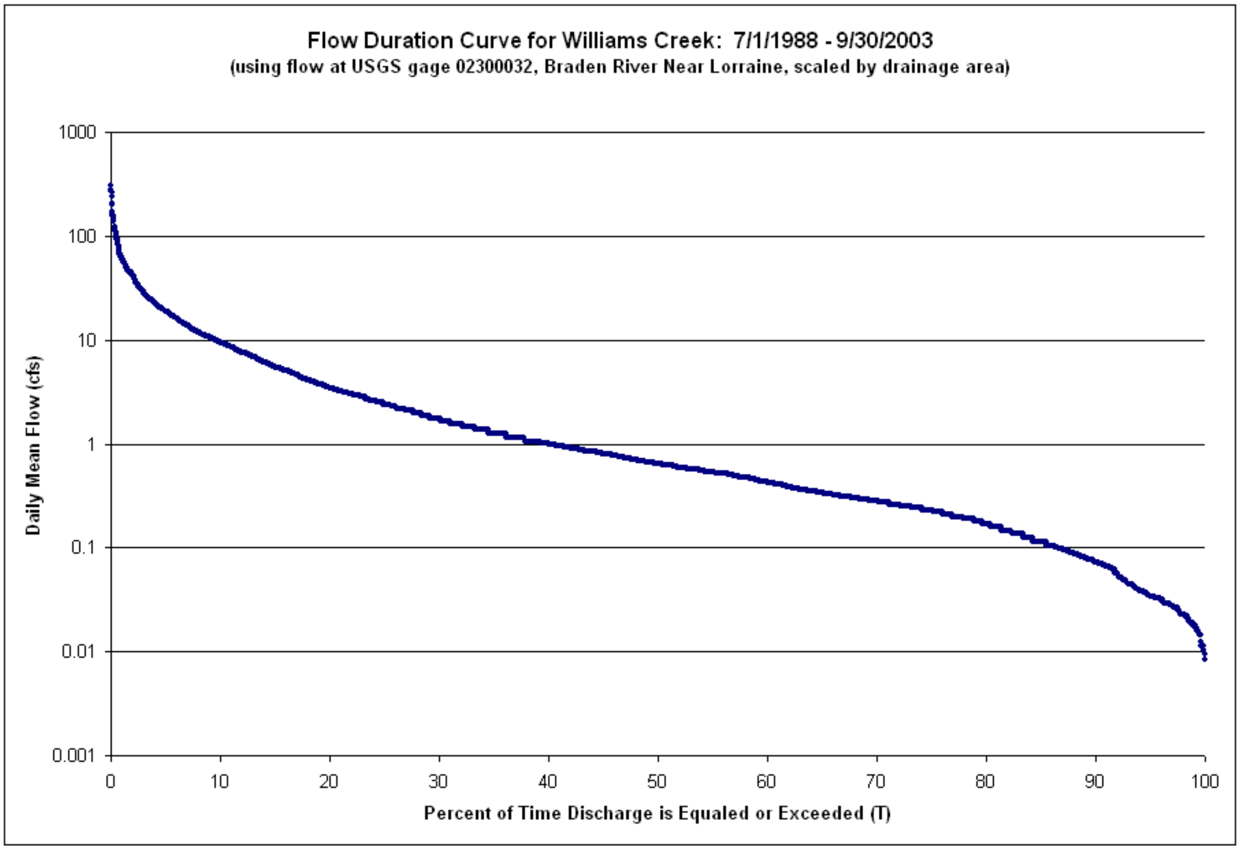
TMDL = 2.41E+10 CFU/day (based on regression line)

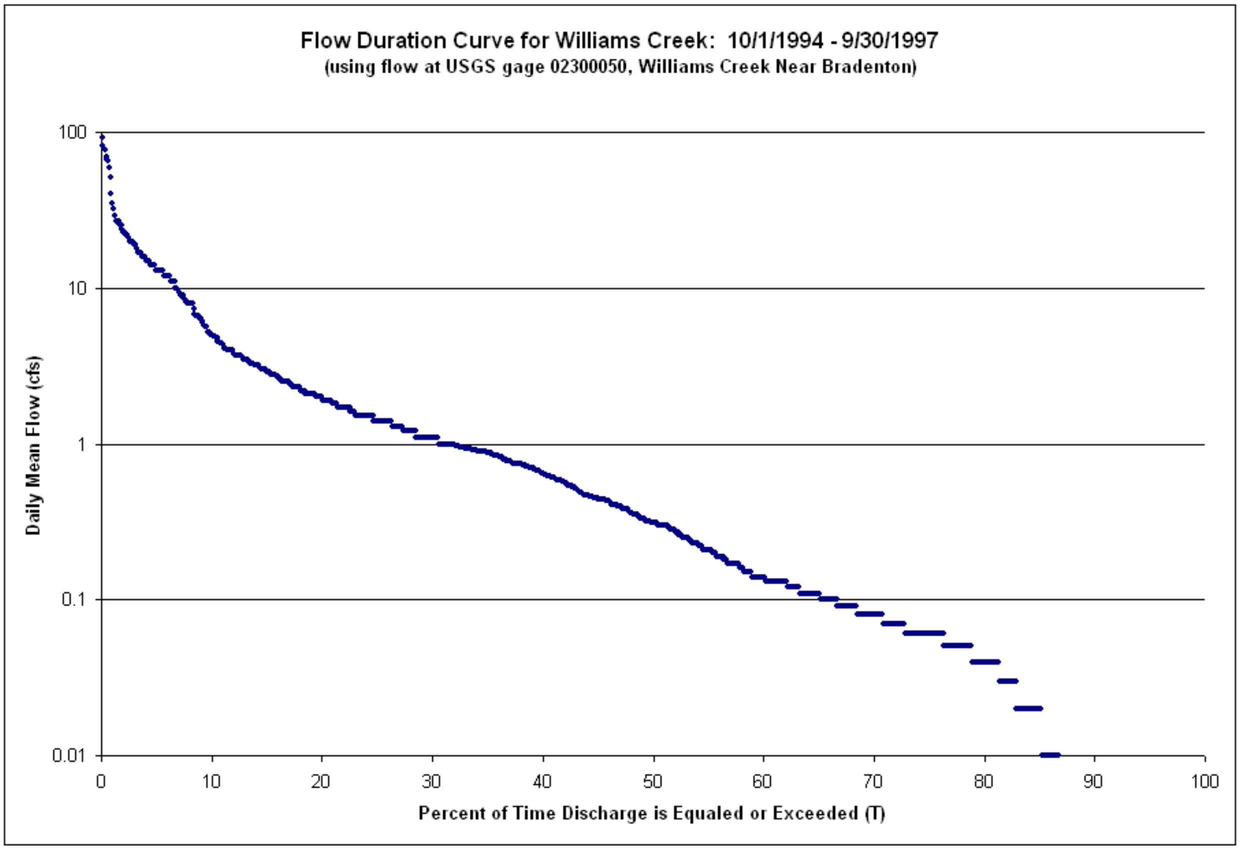
Reduction: 46.2%

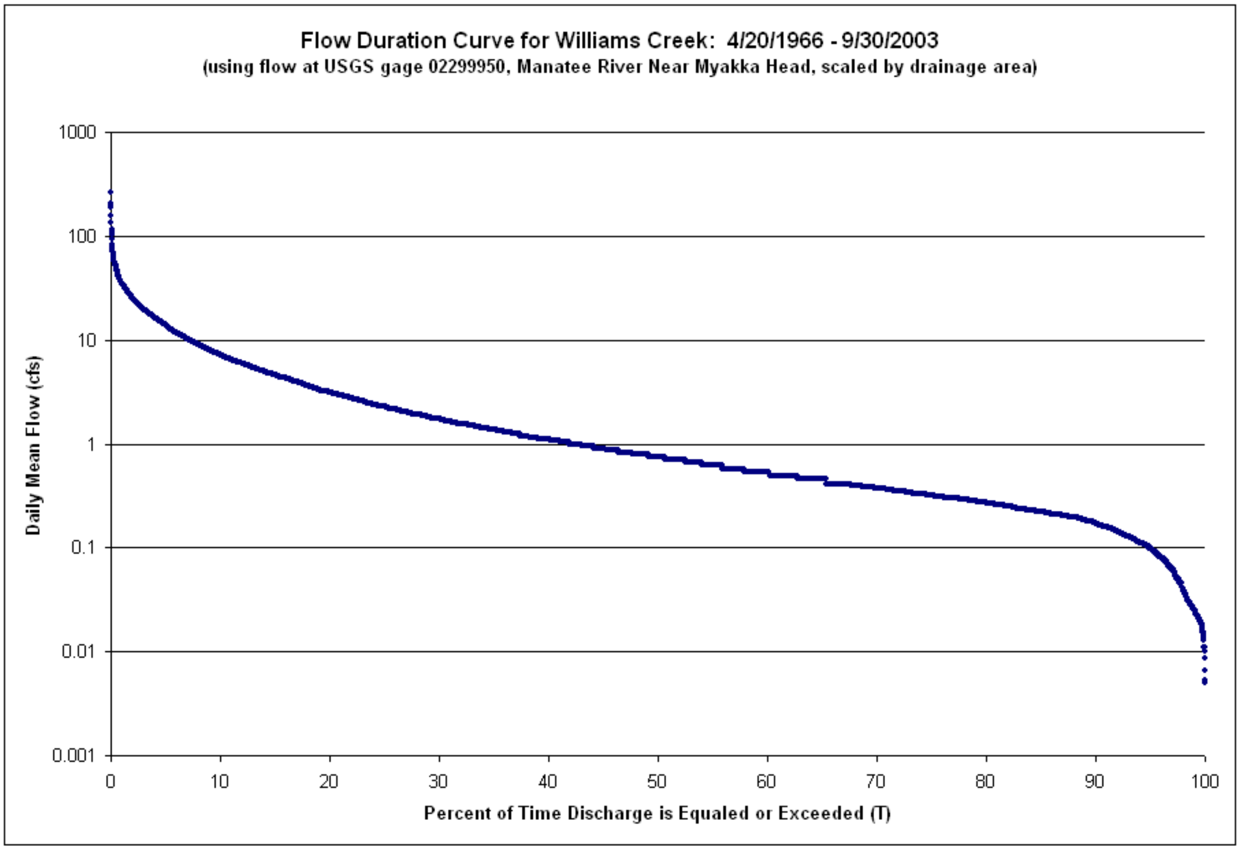
Appendix E: USGS Gage and Flow Data

Historical data collected in the Williams Creek watershed are summarized below.

USGS 02300050, WILLIAMS CREEK NEAR BRADENTON, FL	
Drainage area = 2.7 sq mi	
Statistics	
Minimum Flow (cfs):	0
Maximum Flow (cfs):	93
Average Flow (cfs):	2.508886861
Period Of Record:	10/1/1994 - 9/30/1997
USGS 02300032, BRADEN RIVER NEAR LORRAINE, FL	
Drainage area = 25.80 sq mi	
Statistics	
Minimum Flow (cfs):	0.008372093
Maximum Flow (cfs):	306.627907
Average Flow (cfs):	4.323046533
Period Of Record:	7/1/1988 - 9/30/2003
USGS 02299950, MANATEE RIVER NEAR MYAKKA HEAD, FL	
Drainage area = 65.3 sq mi	
Statistics	
Minimum Flow (cfs):	0.004961715
Maximum Flow (cfs):	266.2787136
Average Flow (cfs):	3.049525439
Period Of Record:	4/20/1966 - 9/30/2003


Flow Duration Curve for Williams Creek: 7/1/1988 - 9/30/2003
(using flow at USGS gage 02300032, Braden River Near Lorraine, scaled by drainage area)
1000
100
10
1
0.1
0.01
0.001
Daily Mean Flow (cfs)
0
10
20
30
40
50
60
70
80
90
100
Percent of Time Discharge is Equaled or Exceeded (T)


Flow Duration Curve for Williams Creek: 10/1/1994 - 9/30/1997
(using flow at USGS gage 02300050, Williams Creek Near Bradenton)
100
10
1
0.1
0.01
Daily Mean Flow (cfs)
0
10
20
30
40
50
60
70
80
90
100
Percent of Time Discharge is Equaled or Exceeded (T)


Flow Duration Curve for Williams Creek: 4/20/1966 - 9/30/2003
(using flow at USGS gage 02299950, Manatee River Near Myakka Head, scaled by drainage area)
Daily Mean Flow (cfs)
1000
100
10
1
0.1
0.01
0.001
0
10
20
30
40
50
60
70
80
90
100
Percent of Time Discharge is Equaled or Exceeded (T)

Appendix F: Ground Water Data in Manatee County

A map of groundwater monitoring sites is presented below, along with a table of related statistics.

GENERATING STATISTICS

NETWORK:	ALL
WATER RESOURCE:	CONFINED UNCONFINED
WATERBODY TYPE:	ALL
HUC:	MANATEE RIVER
COUNTY:	MANATEE
COLLECTION DATE:	FROM: 1-JAN-1980 TO: 8-JUL-2004
RESULTS:	MAX PER WELL

Parameter Name	Coliform, Fecal (MF)	Coliform, Total (MF)	Enterococci, Membrane Filter	Escherichia coli, Membrane Filter
Parameter Code	31616	31501	31649	31648
Units	#/100ml	#/100ml	#/100ml	#/100ml
Total Wells	**5**	**4**	**4**	**4**
Total Samples	**5**	**4**	**4**	**4**
Number BDLs	**5**	**4**	**4**	**4**
Number MCL/GCL Exceedances	**NA**	**0**	**NA**	**NA**
Percent MCL/GCL Exceedances	**NA**	**0%**	**NA**	**NA**
Minimum	**0**	**0**	**0**	**0**
1st Quartile	**0**	**0**	**0**	**0**
Median	**0**	**0**	**0**	**0**
3rd Quartile	**0**	**0**	**0**	**0**
Maximum	**0.5**	**0**	**0**	**0**
Interquartile Range	**0**	**0**	**0**	**0**
Mean	**0.1**	**0**	**0**	**0**
Standard Deviation	**0.224**	**0**	**0**	**0**
Relative Standard Deviation	**224%**	**0%**	**0%**	**0%**
Standard Error	**0.1**	**0**	**0**	**0**
Variance	**0.05**	**0**	**0**	**0**
Coefficient of Skewness	**1339.286**	**0**	**0**	**0**
Number Risk Indicators	**0**	**NA**	**0**	**0**
Percent Risk Indicators	**0%**	**NA**	**0%**	**0%**
Number SRA Indicators	**0**	**0**	**0**	**0**
Percent SRA Indicators	**0%**	**0%**	**0%**	**0%**

Appendix G: Public Comments and Responses

(none received)

Florida Department of Environmental Protection
Division of Water Resource Management
Bureau of Watershed Management
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